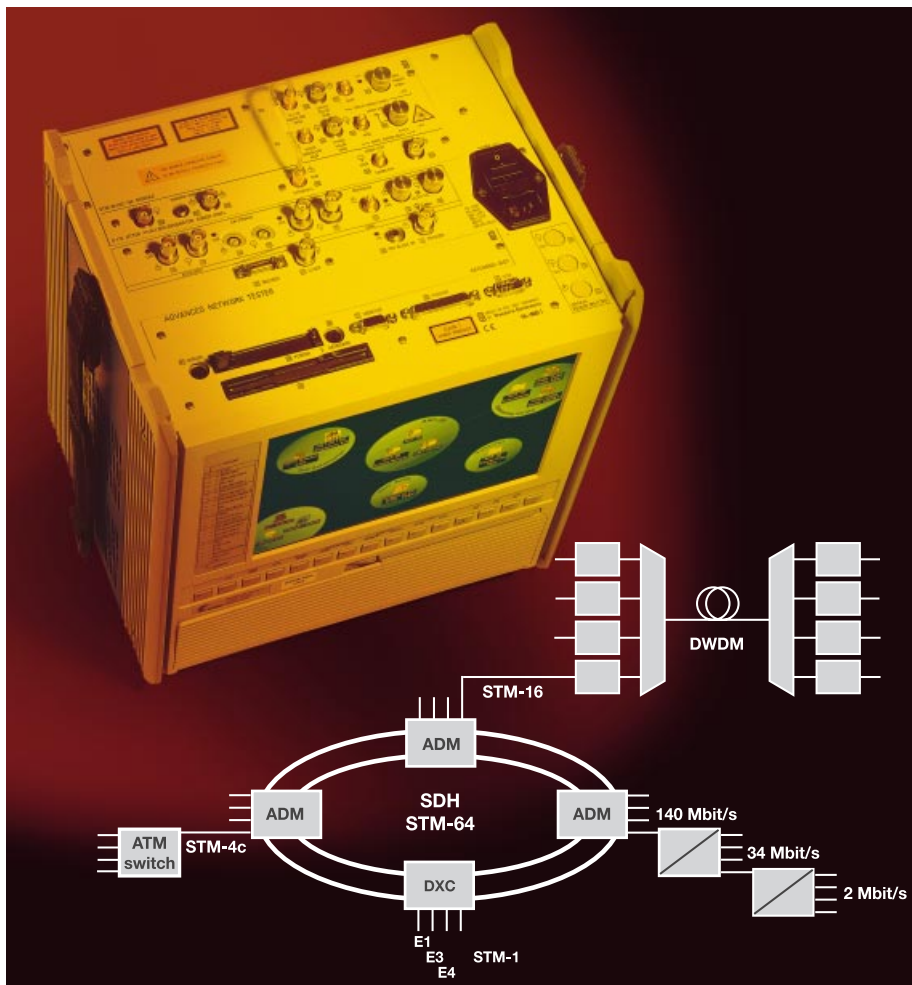


# Acterna ANT-10Gig

## Advanced Network Tester – SDH version



### Realizing future trends

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

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

### 10 Gbit/s in a portable test solution

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

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

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

### STM-64/OC-192

For analyzing digital communications systems

#### Optional:

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

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

Edition: July 2001

**Now with  
jitter testing  
at 10 Gbit/s  
and STM-64c**

<b>Mainframe</b> page 3–10	<b>ANT-10Gig – SDH – Mainframe</b> includes STM-64, STM-4c, STM-16c and STM-64c BERT, STM-1 mappings, Extended overhead analysis	BN 3060/35	<input type="checkbox"/>
<b>SONET</b> page 11	<b>Electrical Interfaces at 10 Gbit/s*</b> <b>Add SONET</b> <b>Add BERT SONET only (interfaces 1.5/6/45 Mbit/s)</b> <b>Drop &amp; Insert/Through mode</b> <b>Mux/Demux 64k/140M</b> <b>Mux/Demux M13</b>	BN 3060/91.48 BN 3060/90.03 BN 3060/90.34 BN 3060/90.10 BN 3060/90.11 BN 3060/90.12	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>Optic</b> page 12–14	<b>STM-0/1, 1310 nm</b> <b>STM-0/1, 1310/1550 nm</b> <b>STM-0/1/4, 1310 nm</b> <b>STM-0/1/4, 1310/1550 nm</b> <b>STM-16, 1310 nm</b> <b>STM-16, 1550 nm</b> <b>STM-16, 1310/1550 nm</b> <b>STM-0/1/4/16, 1310 nm Package</b> <b>STM-0/1/4/16, 1550 nm Package</b> <b>STM-0/1/4/16, 1310/1550 nm Package</b> <b>STM-0/1/4, 1310 nm + STM-16, 1310/1550 nm Package</b> <b>Optical Power Splitter</b>	BN 3060/91.01 BN 3060/91.02 BN 3060/91.11 BN 3060/91.12 BN 3060/91.51 BN 3060/91.50 BN 3060/91.52 BN 3060/91.17 BN 3060/91.18 BN 3060/91.19 BN 3060/91.20 BN 3060/91.05	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>CONCAT.</b> page 13	<b>STM-4c ATM</b> <b>STM-4c Virtual Concatenation</b>	BN 3060/90.91 BN 3060/90.92	<input type="checkbox"/> <input type="checkbox"/>
<b>Jitter/ Wander</b> page 15–20	<b>Jitter/Wander up to 155 Mbit/s Package</b> <b>Jitter/Wander up to 622 Mbit/s Package</b> <b>Jitter at 10 Gbit/s</b> <b>Wander Analyzer at 10 Gbit/s</b> (requires BN 3060/91.60) <b>Wander Generator at 10 Gbit/s**</b> (requires BN 3060/91.60, and either BN 3035/90.81 or BN 3060/91.30 or BN 3060/91.31)	BN 3060/91.30 BN 3060/91.31 BN 3060/91.60 BN 3060/91.61 BN 3060/91.62	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>ATM</b> page 21–26	<b>ATM Basic (PVC)</b> <b>ATM Comprehensive (PVC/SVC)</b> <b>Add ATM SONET (mappings)</b> <b>Add ATM SDH (mappings)</b>	BN 3060/90.50 BN 3060/90.51 BN 3060/90.53 BN 3060/90.52	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>AUTO</b> page 27	<b>Automatic Test Sequencer CATS BASIC</b> <b>Automatic Test Sequencer CATS PROFESSIONAL</b>	BN 3035/95.90 BN 3035/95.95	<input type="checkbox"/> <input type="checkbox"/>
<b>Remote</b> page 27	<b>V.24/RS232 Remote Control Interface</b> <b>GPIO/IEEE Remote Control Interface</b> <b>TCP/IP Remote Control Interface</b> <b>Remote Operation</b>	BN 3035/91.01 BN 3035/92.10 BN 3035/92.11 BN 3035/95.30	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

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

\*\* Please note that the options STM-16/OC-48 or ATM comprehension and Wander Generator at 10 Gbit/s are mutually exclusive.

# Specifications

## The ANT-10Gig Mainframe includes:

- Mainframe, touchscreen
- STM-64 with mappings STM-1, VC-4-4c, VC-4-16c and VC-4-64c BERT
- OC-192 with mappings STS-3c, STS-12c, STS-48c and STS-192c SPE
- Mappings for STM-1: DS1, E1, DS3, E3, E4
- Electrical interfaces STM-1, E1, E3, E4
- Extended overhead analysis
- Two optical adaptors to be selected
- Ethernet and USB interface

## Generator STM-64

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

### Optical interface

Wavelength ..... 1550 nm  
Output level ..... 0 dBm  $\pm$  1dB  
Line code ..... scrambled NRZ

### Clock generator

Internal, accuracy .....  $\pm$  2 ppm  
Offset .....  $\pm$  50 ppm  
Synchronization from external signal

### Generation of STM-64 signal

compliant to ITU-T G.707  
One test channel STM-1 with standard mappings  
or STM-4c bulk or STM-16c bulk,  
others unequipped or same as test channel  
Additionally generation of OC-192 signal compliant to GR-253  
one test channel STS-3c or STS-12c or STS-48c SPE BERT,  
others unequipped or same as test channel

### Contents of STM-64 overhead bytes

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

### Byte sequence

m in n in p for bytes of first 16 STM-1 SOH  
m times (1 to 200 000 0000) byte A  
followed by n times (1 to 2 000 000 000) byte B  
sequence repetition p (1 to 65 000)

### Error insertion

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

### Alarm generation

Alarm types  
LOS, LOF, MS-AIS, MS-RDI, RS-TIM ..... on/off

### Dynamic alarms

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

### Frame trigger [100]

Output voltage (open circuit) ..... CMOS  
Connector/impedance ..... BNC/approx. 50  $\Omega$

# ANT-10Gig (Mainframe)

## Analyzer STM-64

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

### Optical interface

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

### Demultiplexing of STM-64 signal

compliant to ITU-T G.707  
Evaluation of one selectable channel  
STM-1 down to the mapped tributary or STM-4c SPE or STM-16c  
Additionally demultiplexing of OC-192 signal  
compliant to Telcordia GR-253  
Evaluation to one selectable channel STM-4c or STM-16c

# Generator unit PDH/SDH

## Digital outputs

- Interfaces to ITU-T Recommendation G.703
- 75 Ω unbalanced output, adapter jack selectable from Versacon 9 adapter system
- Bit rates and line codes
  - 2048, 8448 and 34 368 kbit/s ..... HDB3, CMI
  - 139 264 and 155 520 kbit/s ..... CMI
- 120 Ω balanced output, Lemosa jack
- Bit rate and line codes
  - 2048 kbit/s ..... HDB3, CMI
- 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 75 Ω unbalanced input, BNC jack:
  - Reference clock ..... 2048 kHz and 1544 kHz
  - 2048 kbit/s (HDB3), 1544 kbit/s (B8ZS) or
  - Receive signal

### Clock outputs

- Clock output at frequency of generator signal, approx. 400 mV (when terminated into 75 Ω), BNC jack.
- 2048 kHz reference clock output via trigger output

## STM-1 output signal

Generation of a STM-1 signal conforming to ITU-T Recommendation G.707

### Mappings

- One selectable STM-1 mapping is included in the basic instrument.
- Other mappings can be added as needed.
- Content of the selected container:
  - Framed or unframed PDH/DSn test pattern
  - PDH multiplex signal (with 64k/140M Mux/Demux chain option)
  - External PDH/DSn signal (with D&I option)
  - Test pattern without stuffing bits (bulk signal to O.181)

Content of non-selected containers ..... framed PRBS 2<sup>11</sup>-1

## STM-1 mappings

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

Modes ..... asynchronous, byte synchronous (floating)

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

### C4 mapping (140 Mbit/s in STM-1 and STS-3c)

### C11 mapping (1.5 Mbit/s in STM-1, AU-3/AU-4, TU11/TU12)

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

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

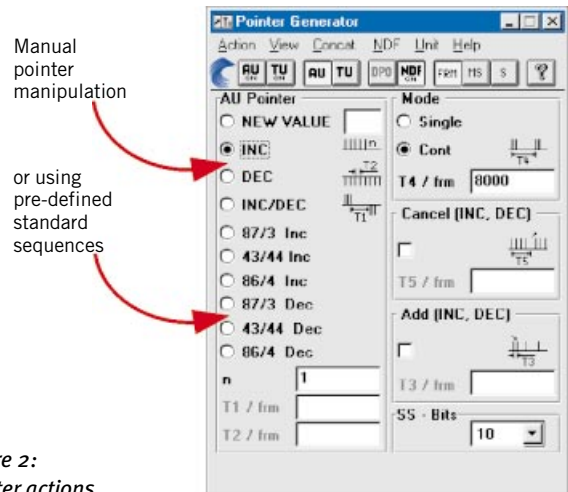


Figure 2: Pointer actions

## Generation of pointer actions (Figure 2)

- Generation of pointer actions at the AU and TU levels simultaneously.
  - Pointer sequences to G.783 with programmable spacing
  - Pointer increment/decrement (continuously repeated)
  - Single pointer
  - Pointer value setting with or without NDF
- Trigger types: Single or continuous repeat

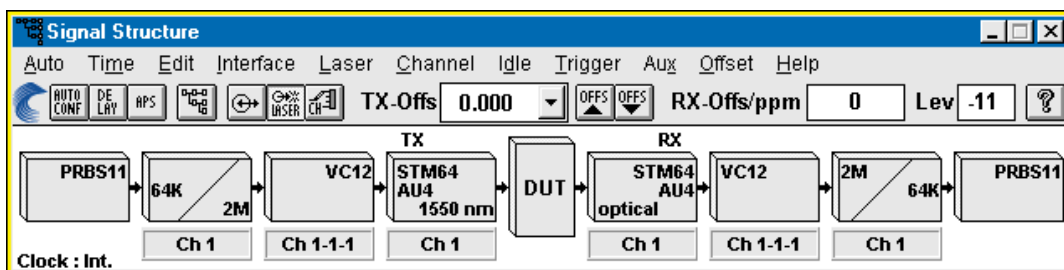


Figure 1: Signal structure

## Content of SOH 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 test pattern with bit error insertion (see test patterns)
- Insertion of an external data signal via V.11 interface (also for K1, K2 and K3)

## 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, BIP2 parity errors, frame alignment signal errors, MS-REI, HP-REI, LP-REI, bit errors in test pattern, code errors (single errors)

Triggering

Single error or error ratio .....  $2 \times 10^{-3}$  to  $1 \times 10^{-10}$   
for B1, B3, HP-REI, LP-REI .....  $2 \times 10^{-4}$  to  $1 \times 10^{-10}$   
for bit errors .....  $1 \times 10^{-2}$  to  $1 \times 10^{-9}$

Step size for mantissa and exponent ..... 1

Burst error: m anomalies in n periods  
For FAS, B1, B2, B3, MS-REI, HP-REI .....  $m = 1$  to  $4.8 \times 10^6$   
and  $n = 2$  to 8001 frames or 0.2 s to 600 s

## Alarm generation

### Dynamic

Alarm types ..... LOF, MS-AIS, MS-RDI, AU-LOP, AU-AIS, HP-UNEQ, HP-RDI, HP-RDIEP, HP-RDIES, HP-RDIEC, TU-LOP, TU-AIS, LP-UNEQ, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI

m alarms in n frames .....  $m = 1$  to  $n-1$ ,  $n_{\max} = 8000$

or

t1 alarm active,  
t2 alarm passive ..... t1 = 0 to 60 s, t2 = 0 to 600 s

### Static (on/off)

Alarm types ..... LOS, LOF, MS-AIS, RS-TIM, MS-RDI, AU-LOP, AU-AIS, HP-UNEQU, HP-PLM, HP-TIM, HP-RDI, HP-RDIEP, HP-RDIES, HP-RDIEC, TU-LOP, TU-AIS, LP-UNEQ, LP-PLM, LP-TIM, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI

## PDH output signals

Signal structures for all bit rates:

- Unframed test pattern
- Framed test pattern (to ITU-T O.150);  
CRC-4 selectable for 2 Mbit/s

### Error insertion

Error types ..... bit errors, FAS errors, code errors (single errors)

Trigger types: Single error or  
error rate .....  $1 \times 10^{-2}$  to  $1 \times 10^{-9}$

Step size for mantissa and exponent ..... 1

### Alarm generation, dynamic

Alarm types ..... LOF, RDI  
m alarms in n frames .....  $m = 1$  to  $n-1$ ,  $n_{\max} = 1000$

### Alarm generation, static (on/off)

Alarm types ..... LOS, LOF, AIS, RDI

## Test patterns

### Pseudo-random bit sequences

PRBS:  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$ ,  $2^{23}-1$ ,  $2^{11}-1$  inv.,  $2^{15}-1$  inv.,  $2^{20}-1$  inv.,  $2^{23}-1$  inv.

### Programmable word

Length ..... 16 bits

## Receiver unit PDH/SDH

## Digital inputs

Interfaces to ITU-T Recommendation G.703

75  $\Omega$  unbalanced input; adapter jack selectable from Versacon 9 adapter system

Bit rates and line codes

2048, 8448 and 34 368 kbit/s ..... HDB3, CMI  
139 264 and 155 520 kbit/s ..... CMI

120  $\Omega$  balanced input, Lemosia jack

Bit rate and line codes

2048 kbit/s ..... HDB3, CMI  
Clock recovery pulling range .....  $\pm 500$  ppm

Selectable input gain

CMI coded ..... 15 to 23 dB  
B3ZS, B8ZS, HDB3, AMI coded ..... 15 to 26 dB

Selectable adaptive equalizers for 1544, 2048, 34 368, 44 736, 51 840, 139 264 and 155 520 kbit/s

Monitor input for STM-1 and STM-4 NRZ signals  
See ANT-10Gig Optical Interfaces data sheet for details.

## Trigger output

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

## Concatenated mappings

### OC-12c/STM-4c BERT

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

Error measurement to O.150

Test pattern ..... PRBS-31, IPRBS-31,  
PRBS-23, IPRBS-23,  
PRBS-20,  
PRBS-15, IPRBS-15

### Programmable word

Length ..... 16 bits

### Error insertion

Bit errors in test pattern, single error or  
error ratio .....  $1 \times 10^{-2}$  to  $1 \times 10^{-9}$

### Error measurement and alarm detection

Bit errors and AIS in test pattern

## OC-48c/STM-16c BERT

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

Error measurement to O.150

Test pattern ..... PRBS-31, IPRBS-31  
 PRBS-23, IPRBS-23

### Programmable word

Length ..... 16 bits

### Error insertion

Bit errors in test pattern, single error or  
 error ratio .....  $1 \times 10^{-3}$  to  $1 \times 10^{-9}$

### Alarm generation:

AU-AIS, AIS-C1...AIS-C16,  
 AU-LOP, LOP-C1...LOP-C16

### Error measurement and alarm detection:

AU-AIS, AU-LOP  
 Bit errors

### Automatic Protection Switching

Sensor: MS-AIS, AU-AIS

## OC-192c/STM-64c BERT

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

Error measurement to O.150

Test pattern ..... PRBS-31, IPRBS-31

### Programmable word

Length ..... 16 bits

### Error insertion

Bit errors in test pattern, single error or  
 error ratio .....  $1 \times 10^{-3}$  to  $1 \times 10^{-9}$

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

### Error measurement and alarm detection:

AU-AIS, AU-LOP  
 Bit errors

## Automatic modes

### Autoconfiguration

Automatically sets the ANT-10Gig to the input signal. The routine searches at the electrical and optical interfaces for the presence of standard PDH and STM-N signals (G.703, G.707, O.151, O.181) and the payload contents in channel 1.

### Automatic SCAN function

The SCAN function permits sequential testing of all C11 or C12 channels via AU-3 or AU-4 in a SDH signal.

The ANT-10Gig 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. The generator runs simultaneously and can be used to stimulate the device under test.

### Automatic TROUBLE SCAN function (Figure 3)

The TROUBLE SCAN function permits sequential testing of all C11 or C12 channels via AU-3 or AU-4 in a SDH signal. The ANT-10Gig receiver checks for alarms in the receive signal, the SDH structure and all channels. The results (OK/not OK) for each channel are entered in a matrix.

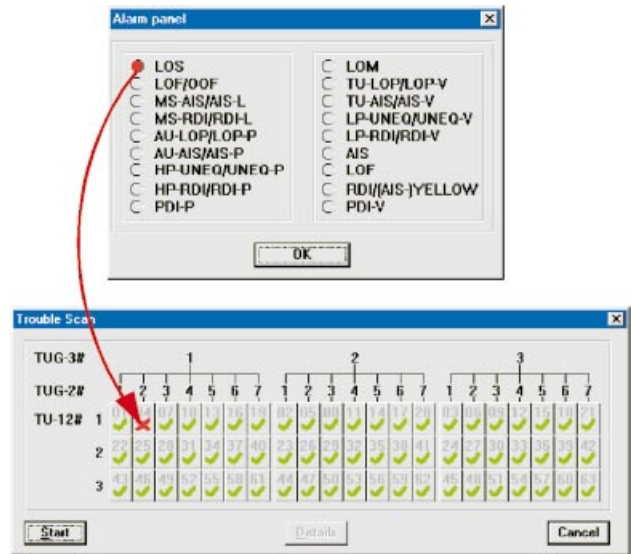


Figure 3: Trouble scan

A detailed alarm history can be displayed by selecting a channel from the matrix. The alarm status of individual channels can be displayed following the measurement. Only the receive channels are altered during a TROUBLE SCAN.

### AutoScan function (Figure 4)

This automatic “AutoScan” function allows you to rapidly check the signal structure, the mapping used and the payload – even with mixed mapped signals.

The ANT-10Gig receiver analyzes the incoming received signal and provides a clear overview of all the signals present in the composite receive signal. The variable scan depth setting allows even complex signal structures to be resolved and displayed clearly. Even Trace Identifiers are evaluated. All the displayed results can be printed out.

### 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 (C11 or C12 with defined PRBS) in the payload of a SDH signal. The ANT-10Gig 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.

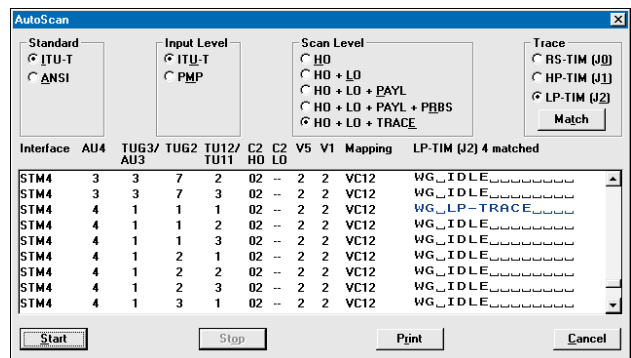


Figure 4: AutoScan

# Measurement types

## Error measurements

Error types . . . . . B1, B2, B3, BIP2 parity errors, MS-REI, HP-REI, LP-REI, bit errors in test pattern, code errors

### G.821:

#### Evaluation of PDH and SDH systems to ITU-T Recommendation

ES, EFS, SES, DM and UAS are evaluated. Pass/fail assessment based on line length allocation of 0.1 to 100%. The SES and DM thresholds are user-settable. Evaluation for higher bit rates (up to 140 Mbit/s) is obtained using a multiplex factor as per G.821, Annex D.

Measurements can be made using the following events:  
 PDH systems . . . . . bit errors, FAS2, FAS8, FAS34 FAS140, CRC and E-bit errors  
 SDH systems . . . . . payload bit errors (PDH and bulk), overhead bytes E1, E2, F2, D1 to D3, D4 to D12

### G.826:

#### Evaluation to ITU-T Recommendation

EB, BBE, ES, EFS, SES and UAS are evaluated. Pass/fail assessment based on line length allocation of 0.1 to 100%. The SES and UAS thresholds are user-settable.

*In-Service Measurement (ISM)*  
 Simultaneous in-service measurement of near end and far end of a selected path:  
 – Near end: B1, B2, HP-B3, LP-B3, BIP2, FAS at 140/34/8 or 2 Mbit/s, CRC-4  
 – Far end: HP-REI, LP-REI, E-bit at 2 Mbit/s

*Out-of-Service Measurement (OOS)*  
 Out of service measurement using bit errors in the test pattern (for PDH and SDH).

### G.828 and G.829:

#### Evaluation of SDH systems to ITU-T Recommendation (Figure 5)

The G.828 defines error performance parameters and objectives for international synchronous paths. ES, EFS, SES, BBE, SEP and UAS are evaluated. Pass/fail assessment based on line length allocation of 0.1 to 100%. The SES and UAS thresholds are user-settable. The SEP can be switched off for assessment. The recommendation G.829 defines error performance events and block structures for SDH multiplex and regenerator sections.

### M.2100:

#### Evaluation of PDH and SDH systems to ITU-T Recommendation

This recommendation describes requirements during line-up and maintenance (in-service). ES, EFS, SES and UAS are evaluated. Pass/fail assessment based on line length allocation of 0.1 to 100%. The UAS and BISO (bringing into service objectives) thresholds are user-settable. ISM simultaneously for near end and far end of a selected path:

G.828: MSOH	NEAR END: B2SUM	FAR END: MS-REI
ES	0 0.00000 %	0 0.00000 %
EFS	28 100.00000 %	28 100.00000 %
SES	0 0.00000 %	0 0.00000 %
BBE	0 0.00000 %	0 0.00000 %
SEP	0 0.00000 %	0 0.00000 %
UAS	0 0.00000 %	0 0.00000 %
VERDICT	Accepted	Accepted
PATH ALLOCATION	18.50000 %	
PATH UAS	*	

Figure 5: Performance analysis to ITU-T G.828/G.829

PDH systems, near end . . . . . bit errors, FAS2, FAS8, FAS34, FAS140, CRC-4  
 far end . . . . . E-bit at 2 Mbit/s  
 SDH systems . . . . . payload bit errors (PDH and bulk), overhead bytes E1, E2, F2, D1 to D3, D4 to D12  
 This operating mode allows application of the “Bringing into Service” procedures as per ITU-T Rec. **M.2110** and the determination of “Performance Information” as per ITU-T Rec. **M.2120**.

### M.2101:

#### Evaluation of SDH systems to ITU-T Recommendation (Revision 09/99)

This recommendation describes requirements during line-up and maintenance (in-service) ES, EFS, BBE, SEP, SES and UAS are evaluated according to the newest Revision of M.2101. Pass/fail assessment based on line length allocation of 0.1 to 100%. The UAS and BISO (bringing into service objectives) thresholds are user-settable. ISM simultaneously for near end and far end of a selected path or Multiplex Section:  
 Evaluated anomalies . . . . . payload bit errors (TSE), B1, B2, B3 and BIP2, MS-REI, HP-REI, LP-REI  
 This operating mode allows application of the “Bringing into Service” procedures as per ITU-T Rec. **M.2110** and the determination of “Performance Information” as per ITU-T Rec. **M.2120**.

### Analysis of AU and TU pointer actions (Figure 6)

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.

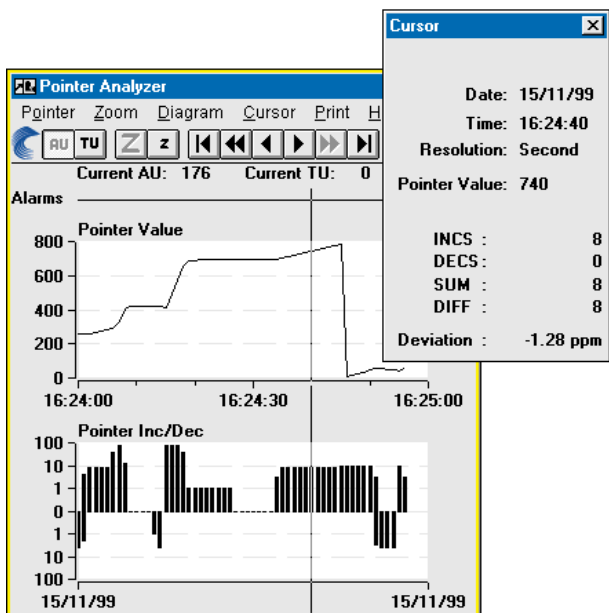


Figure 6: Graphic pointers. Display showing additional evaluation of cursor position.

## Delay measurement

A delay measurement is used to line-up satellite hops, to test the maximum permitted latency in storage exchanges and cross-connect systems and to check the loop circuits of regenerators. The ANT-10Gig measures the time taken for the test pattern to be transmitted from the generator back to the receiver via the path under test. The measurement is made on the test patterns in the selected channel, in the containers (bulk or PDH) for SDH or in the selected channel at the lowest hierarchy level of PDH multiplex systems. To avoid ambiguities in the measurement, two measurement times are provided.

Measurement range

Bit rates from 8 to 155 Mbit/s ..... 1  $\mu$ s to 1 s  
 Bit rate 2 Mbit/s ..... 10  $\mu$ s to 5 s  
 Bit rate 64 kbit/s ..... 100  $\mu$ s to 16 s

## Alarm detection

All alarms are evaluated and displayed in parallel

Alarm types. .... LOS, OOF, LOF, MS-AIS, MS-RDI, RS-TIM, LTI, AU-AIS, AU-LOP, AU-NDF, HP-RDI, HP-UNEQ, HP-TIM, HP-PLM, AIS, RDI, LSS, TU-NDF, TU-LOP, TU-AIS, LP-UNEQ, LP-RDI, LP-RDIEP, LP-RDIES, LP-RDIEC, LP-RFI

## 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

## SOH and POH evaluation

- Display of complete SOH 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 and K3)

For the Trace Identifier

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

## Ring testing – APS time measurement (Figure 7)

In synchronous networks, a defined maximum switch-over time is necessary for the traffic in case of a fault.

To verify compliance with this requirement, the ANT-10Gig measures the switch-over time with 1 ms resolution.

The result can be printed.

Criteria for the time measurement .....	TU-AIS, MS-AIS, AU-AIS, bit error
Max. measurable switch-over time .....	2 s
Resolution .....	1 ms
Allowable error rate for user signal .....	$< 2 \times 10^{-4}$

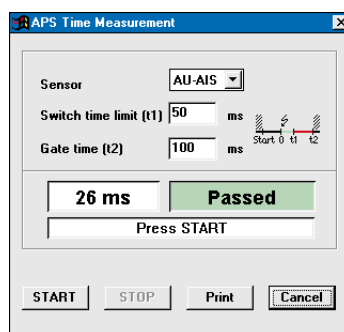


Figure 7: APS time measurement

## Ring testing – Byte capture SOH and POH

To analyze the SOH/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 STM-0/1, el. & opt. .... all SOH/POH bytes  
 STM-N el. & opt. .... all SOH/POH bytes, channel 1 except A1, A2, B1

Storage depth for a byte ..... 266  
 K1, K2 ..... 200

Trigger events ..... MS-AIS, AU-AIS, MS-RDI, AU-LOP, editable value in trigger byte

Capture resolution ..... frame precision



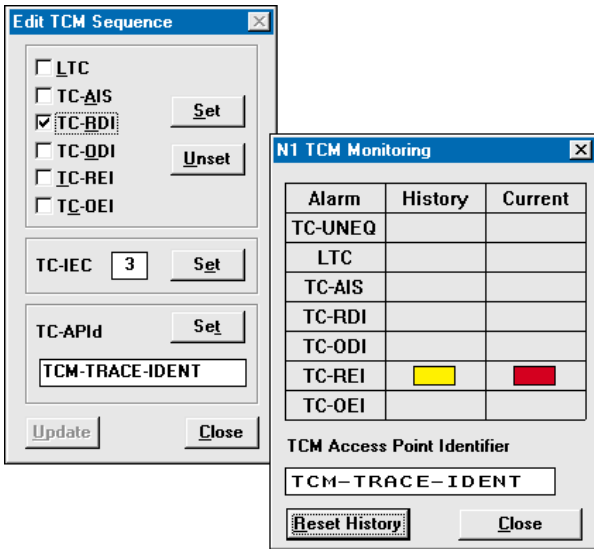


Figure 8: TCM monitor and editor

## Tandem Connection Monitoring (TCM) (Figure 8)

TCM is a method used to monitor the performance of a subsection of a SDH path via the N1/N2 bytes. This is particularly useful when the path is routed via different network providers. If errors occur on an end-to-end connection, you can use TCM to determine which subnetwork the errors occurred in.

The ANT-10Gig helps to monitor the content of the N1/N2 bytes and provides users with easy interpretation of the detailed events.

Capture TCM frames ..... all N1/N2 bytes,  
TC-IEC, TC-AIS, TC-REI, TC-OEI  
Trigger events ..... Start of TCM frame (TCM FAS word)  
Storage depth ..... 266 bytes (3.5 TCM frames)

On-line monitoring of alarms and trace identifier.  
Display of actual and history values ..... TC-UNEQ, LTC,  
TC-AIS, TC-RDI, TC-ODI, TC-REI, TC-OEI

On-line display of TCM Access Point Identifier

TCM error measurement  
Error types ..... TC-IEC, TC-DIFF, TC-REI, TC-OEI

## TCM Byte Sequencer and Editor

This serves to test a sequential TCM process (Tandem Connection Monitoring) in the N1/N2 bytes. A sequence of 76 bytes simulating a TCM frame (equivalent frame) is generated. Individual values can be edited as binary or hexadecimal values to simulate various events for TCM evaluations.

Additionally major events may be simulated, line alarm, errors and trace identifier

Alarms ..... TC-ODI, TC-AIS, TC-RDI  
Errors ..... TC-OEI, TC-IEC  
Trace ..... TC-APID

## Result display and instrument operation

### Numerical display

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

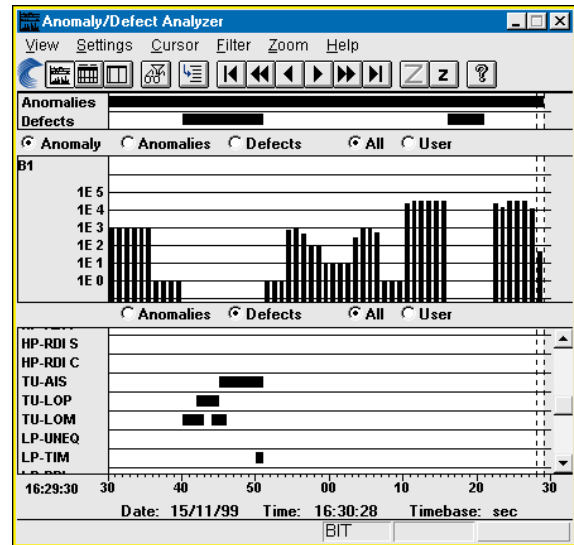


Figure 9: Histogram results display

## Graphical display (histogram) (Figure 9)

Display of errors, pointer operations/values and alarms as bargraphs vs. time

Units, time axis ..... seconds, minutes,  
15 minutes, hours, days

## Tabular display

Display of all alarm and error events with time stamp

## Result printout

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

## Printer interfaces

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

## Result export

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

## Instrument operation

ANT-10Gig is operated using the standard Microsoft® Windows™ graphical user interface.

Operation is menu-controlled using the trackball or touchscreen. A mouse can also be connected if desired.

## Application selection and storage

ANT-10Gig includes an applications library to which customer-specific applications can be added.

All applications are stored internally on the built-in hard disk drive and can be copied to any other ANT-10Gig via floppy disk or super disk.

Easy to use filter functions allow quick selection of the desired application.

## Touchscreen Display

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

### Built-in PC

ANT-10Gig uses a Pentium PC as internal controller so that standard PC applications can also be run on the instrument.

RAM capacity ..... 64 MB  
LS 120 drive ..... 3.5", 120 MB  
Hard disk drive ..... 6 GB  
USB interface, 10/100 Mbit 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 access to GPIB, LANs, etc., via adapter cards.

### Power outage function

In the event of an AC line power failure during a measurement, ANT-10Gig saves all data. As soon as the AC line voltage is 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

AC line voltage, automatic switching ..... 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 ..... +5 to +40 °C  
Storage and transport range ..... -20 to +70 °C

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

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

# Options

## Electrical Interfaces at 9953 Mbit/s

**BN 3060/91.48**

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

### Generator unit

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

### Receiver unit

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

### Clock

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

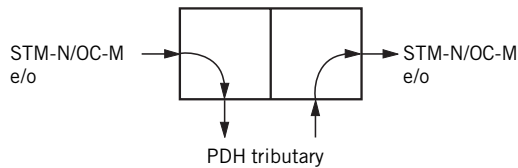
## Drop & Insert

**BN 3060/90.10**

This option provides the following functions:

### 1. Generator and receiver operate independently

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



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

available for all bit rates up to 10 Gbit/s

The received signal is looped through the ANT-10Gig and re-transmitted (generator and receiver coupled).

The looped-through synchronous signal can be manipulated if required:

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

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

This option provides  $n \times 64$  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 (for STM-0 mappings please select the option "Add SONET").

Alarms and errors can be generated and analyzed.

## M13 MUX/DEMUX chain

**BN 3060/90.12**

M13 multiplexers are used in North America in hybrid networks and synchronous system cross-connects.

This option provides  $n \times$  DS0 to DS3 multiplex and demultiplex functions. The output signal is fed to the electrical interface and is available as payload in mappings (requires option "Add SONET").

Alarms and errors can be generated and analyzed.

## Add SONET

**BN 3060/90.03**

### VT1.5 SPE mapping

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

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

6 Mbit/s unframed/Bulk in STS-1

### STS-1 SPE mapping

DS3 in STS-1 and 45 Mbit/s in STM-0

### VT2 SPE and STM-0 mapping

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.

### BERT (1.5/6/45 Mbit/s)

Signal structure and interfaces for generator and receiver:

Framed and unframed test patterns (6 Mbit/s unframed)

Additional test pattern ..... QRSS 20

Additionally, for unbalanced digital signal input/output

Bit rate, line code ..... 1544 kbit/s, 6312 kbit/s, B8ZS, AMI

Bit rate, line code ..... 44 736 kbit/s, B3ZS

Additionally, for balanced digital signal input/output

Bit rate, code ..... 1544 kbit/s, B8ZS

# Optical Options

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

## Optical Modules up to 155 Mbit/s

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

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

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

### Generator unit

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

There are two options for adapting to the required wavelength:

Wavelength ..... 1310 nm,  
    1310 & 1550 nm (switchable in the instrument)

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

### Receiver unit

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

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

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

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

## Optical Modules up to 622 Mbit/s

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

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

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

### Generator unit

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

Classes L1.1, L1.2, L1.3, L4.1, L4.2 and L4.3 (LR-1, LR-2, LR-3) are covered.

There are two options for adapting to the required wavelength:

Wavelength ..... 1310 nm,  
    1310 & 1550 nm (switchable in the instrument)

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

### Generation of 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
- one internally generated STS-3c tributary signal with the other three tributaries filled with UNEQ.

with STS-3c mapping option or ATM Basic Option BN 3060/90.50

### Contents of the STM-4/OC-12 overhead bytes

For all bytes except B1, B2 and H1 to H3:

- The content of each byte is statically programmable or a user defined byte-sequence p in m in n (p frames in m frames and the entire sequence repeated n times) can be inserted.

For the E1, E2, F1 bytes and the DCC channels

D1 to D3 and D4 to D12:

- Transmission of a test pattern with bit error insertion (see mainframe for pattern selection)
- Insertion of an external data signal (via the V.11 interface)

For the K1, K2, N1, N2 bytes:

- Insertion of the data signal via the V.11 interface

For the J0 bytes:

- Transmission of a 16-byte sequence, with CRC

### Error insertion

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

### Triggering

Single errors or error ratio .....  $2 \times 10^{-3}$  to  $1 \times 10^{-10}$   
for B1 parity errors .....  $2 \times 10^{-4}$  to  $1 \times 10^{-10}$

Burst error: m anomalies in n periods

For FAS, B1, B2, B3, REI-L, REI-P .....  $m = 1$  to  $4.8 \times 10^6$  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 ITU-T Rec. G.957 (Telcordia GR-253, ANSI T1.105.06) and fulfills classes S1.1, S1.2, S4.1, S4.2, L4.1, L4.2 and L4.3 (IR-1, IR-2, LR-1, LR-2, LR-3).

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

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

The ANT-10Gig 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-TM  
 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-10Gig 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

**Option OC-12c/STM-4c Virtual Concatenation** **BN 3060/90.92**  
 Only in conjunction with BN 3060/90.90 or BN 3060/90.91

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

**Generation of pointer actions**  
 Manipulations on pointer #1 as in basic data sheet  
 Setting of delta values for pointers #2, #3, #4

**Pointer analysis**  
 For pointer #1 . . . . . as in basic data sheet  
 Delta values (maximum, minimum) . . . . . ±40  
 for pointers #2, #3, #4

**POH generation/analysis**  
 POH #1 . . . . . as in basic data sheet  
 POH #2, #3, #4 . . . . . static setting of all bytes except B3  
 Automatic B3 generation for VC-4 #1, #2, #3, #4

**Option OC-12c/STM-4c ATM-Testing** **BN 3060/90.91**  
 Only in conjunction with BN 3060/90.50 and BN 3060/91.11 or BN 3060/91.12

See chapter “ATM options” for further details.

## Optical Modules 2488 Mbit/s

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

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

The optical interfaces meet the specifications of 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 intern. 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 3060/90.90 required)  
 - One STM-4c tributary (Option BN 3060/90.90 required)  
 and 3 × UNEQ/non specific

**Generation of OC-48 TX signal**  
 In instruments with STS-1/STS-3c mappings  
 The OC-48 signal consists of one or more intern. generated tributaries plus several tributaries filled with UNEQ (or non-specific UNEQ)  
 - 48 identical STS-1  
 - One STS-1 tributary and 47 × UNEQ/non specific  
 - 16 identical STS-3c (Option BN 3060/90.02 required)  
 - One STS-3c tributary (Option BN 3060/90.02 required)  
 and 15 × UNEQ/non specific  
 - 4 identical STS-12c (Option BN 3060/90.90 required)  
 - One STS-12c tributary (Option BN 3060/90.90 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 .....	$1 \times 10^{-10}$ to $2 \times 10^{-5}$
B2 .....	$1 \times 10^{-10}$ to $2 \times 10^{-3}$
additionally, for STM-16 .....	MS-REI
for OC-48 .....	REI-L
Single error or error rate .....	$1 \times 10^{-10}$ to $2 \times 10^{-3}$

#### 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 to -8 dBm
Input overload .....	>-8 dBm

Display of optical input level

Range .....	-30 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

## DWDM laser

**Optical STM-64, OC-192, 15xy nm  
Special DWDM lasers to G.692**

**BN 3060/91.49**

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

## Further options

**Optical Power Splitter (90%/10%)**

**BN 3060/91.05**

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

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

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

The optical power splitter operates in the following ranges:

Wavelengths .....

# Jitter and Wander Options

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

## Standards

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

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

### Jitter generator

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

#### Bit rates

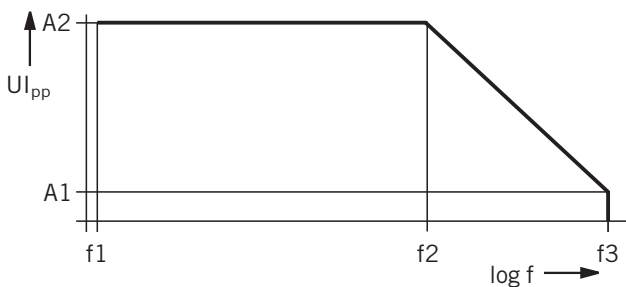
Generates jitter at all bit rates included in the mainframe configuration up to 155 520 kbit/s.

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

Built-in modulation generator (sinewave) ..... 0.1 Hz to 5 MHz

External modulation ..... 0 Hz to 5 MHz

Jitter amplitude ..... up to 64 UI



Clock rate/kHz	A1	A2	f1/Hz	f2/Hz	f3/kHz		
1 544	0.5	64	0.1	625	80		
2 048				1 560	200		
6 312				940	120		
8 448				6 250	800		
34 368				27 k	3 500		
44 736				35 k	4 500		
51 840				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 3060/91.31

### Modulator input

75 Ω, BNC socket

Voltage required ..... 0 to 2 V<sub>pp</sub>

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

### Jitter Analyzer

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

### Built-in filters

High-pass filters ..... 0.1, 2, 4, 10, 20, 40, 100, 200, 400, 500, 700 Hz,

1, 3, 8, 10, 12, 18, 20, 30, 65, 80, 250 kHz

Low-pass filters ..... 40, 60, 100, 400, 800, 1300, 3500, 5000 kHz

Filter characteristics ..... as per O.172

### Measurement ranges

#### Peak-peak

Range I, Resolution ..... 0 to 1.6 UI<sub>pp</sub>, 1 mUI<sub>pp</sub>

Range II, Resolution ..... 0 to 20 UI<sub>pp</sub>, 10 mUI<sub>pp</sub>

Range III, Resolution ..... 0 to 200 UI<sub>pp</sub>, 100 mUI<sub>pp</sub>

#### RMS

Range I, Resolution ..... 0 to 0.8 UI<sub>pp</sub>, 1 mUI<sub>pp</sub>

Range II, Resolution ..... 0 to 10 UI<sub>pp</sub>, 10 mUI<sub>pp</sub>

Range III, Resolution ..... 0 to 100 UI<sub>pp</sub>, 100 mUI<sub>pp</sub>

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

### Demodulator output

75 Ω, BNC socket

Range I (0 to 1.6 UI<sub>pp</sub>) ..... 1 V/UI<sub>pp</sub>

Range II (0 to 20 UI<sub>pp</sub>) ..... 0.1 V/UI<sub>pp</sub>

Range III (0 to 200 UI<sub>pp</sub>) ..... 0.01 V/UI<sub>pp</sub>

### Wander Generator

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

#### Bit rates

Wander generation at all implemented bit rates up to 155 Mbit/s according to the equipment level of the instrument.

Amplitude range ..... up to 200 000 UI

Frequency range ..... 10 μHz to 10 Hz

Accuracy ..... as per O.172

Resolution ..... 1 μHz

### Wander Analyzer

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

For all bit rates up to 155 Mbit/s according to the equipment level of the instrument.

Other sampling rates in addition to the 30/s rate are available for detailed analysis versus time:

Sampling rate – low-pass filter –

test duration ..... 1/s - 0.1 Hz - 99 days

30/s - 10 Hz - 99 h

60/s - 20 Hz - 99 h

300/s - 100 Hz - 5000 s

Amplitude range ..... ±1 ns to ±1 μs

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

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

# 0.172 Jitter/Wander up to 622 Mbit/s BN 3060/91.31

## Jitter Generator

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

## Jitter modulation of externally-generated signals in Through mode

Externally-generated signals can be jittered in Through mode when the D&I option is included.

This applies to all bit rates included in the mainframe configuration at the appropriate electrical and optical interfaces.

Built-in modulation generator (sinewave) ..... 0.1 Hz to 5 MHz  
 External modulation ..... 0 Hz to 5 MHz  
 Jitter amplitude ..... as for jitter generator in UIpp

## Jitter Analyzer

### Measurement range

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

### RMS

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

### Demodulator output

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

## Wander Generator

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

### Bit rates

Wander generation at all implemented bit rates up to 622 Mbit/s according to the equipment level of the instrument.

Amplitude range ..... up to 200 000 UI  
 Frequency range ..... 10 μHz to 10 Hz  
 Accuracy ..... as per O.172  
 Resolution ..... 1 μHz

## Wander Analyzer

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

Other sampling rates in addition to the 30/s rate are available for detailed analysis versus time:

Sampling rate – low-pass filter –  
 test duration ..... 1/s - 0.1 Hz - 99 days  
 ..... 30/s - 10 Hz - 99 h  
 ..... 60/s - 20 Hz - 99 h  
 ..... 300/s - 100 Hz - 5000 s

Amplitude range ..... ± 1 ns to ± 1 μs  
 Measurement accuracy ..... as per O.172

### Reference signal input

Frequencies ..... 1.544, 2.048, 5, 10 MHz  
 Bit rates ..... 1.544, 2.048 Mbit/s  
 Balanced 110 Ω connector ..... Bantam

Clock input voltage (sine or square wave) ..... 1.0 to 6.5 Vpp  
 HDB3/B8ZS input voltage ..... ± 3 V ± 10%

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

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

# 0.172 Jitter/Wander at 9953 Mbit/s

## Jitter at 9953 Mbit/s

BN 3060/91.60

## Wander Analyzer at 9953 Mbit/s

BN 3060/91.61

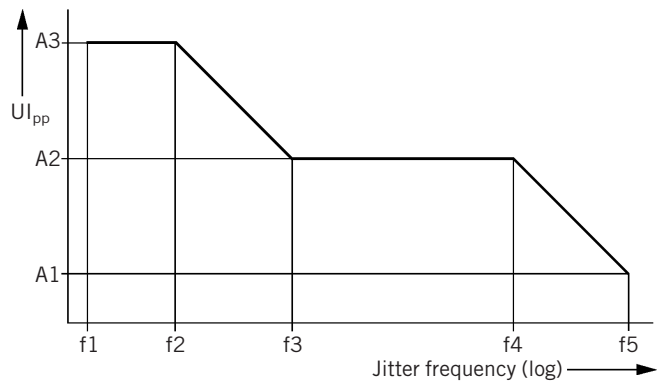
## Wander Generator at 9953 Mbit/s

BN 3060/91.62

## Jitter Generator

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

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



Amplitude in UIpp			Frequency in Hz				
A1	A2	A3	f1	f2	f3	f4	f5
0.5	20	3200	0.1	12.5	2 k	2 M	80 M

### Modulator input

75 Ω, BNC socket  
 Modulation frequency ..... 0.1 Hz to 80 MHz  
 Input voltage range ..... 0 to 2.0 Vpp  
 Error limits ..... as per ITU-T O.172

## Jitter Analyzer

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

### Measurement ranges

Peak-peak  
 Range I, Resolution ..... 0 to 4 UIpp, 1 mUIpp  
 Range II, Resolution ..... 0 to 40 UIpp, 10 mUIpp  
 Range III, Resolution ..... 0 to 3200 UIpp, 100 mUIpp

### RMS

Range I, Resolution ..... 0 to 2 UIpp, 1 mUIpp  
 Range II, Resolution ..... 0 to 20 UIpp, 10 mUIpp  
 Range III, Resolution ..... 0 to 1600 UIpp, 100 mUIpp

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



### Built-in filters

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

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

### Demodulator output

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

### Wander Generator

Requires option BN 3035/90.81 or BN 3060/91.30 or BN 3060/91.31  
Fully complies with or exceeds the requirements of ITU-T O.172.

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

### Wander Analyzer

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

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

### Reference signal input

- Frequencies . . . . . 1.544, 2.048, 5, 10 MHz
- Bit rates . . . . . 1.544, 2.048 Mbit/s
- Balanced 110 Ω connector
- Clock input voltage
- (sine or square wave) . . . . . 0.65 to 6.5 Vpp
- HDB3/B8ZS input voltage . . . . . ± 3 V ± 10%
- Coaxial 75 Ω connector
- Clock input voltage
- (sine or square wave) . . . . . 0.5 to 5 Vpp
- HDB3/B8ZS input voltage . . . . . ± 2.37 V ± 10%
- For “Standard Frequency Source” accessory for wander applications, see end of section

## Jitter Analysis

- Current values (continuous measurement)
- Peak jitter value . . . . . in UIpp
- Positive peak value . . . . . in UI+p
- Negative peak value . . . . . in UI-p
- Maximum value (gated measurement)
- Maximum peak jitter value . . . . . in UIpp
- Maximum positive peak value . . . . . in UI+p
- Maximum negative peak value . . . . . in UI-p
- Result averaging (switchable) . . . . . 1 to 5 s
- The ANT-10Gig retains phase synchronicity even when pointer jitter occurs (phase tolerance to O.172).

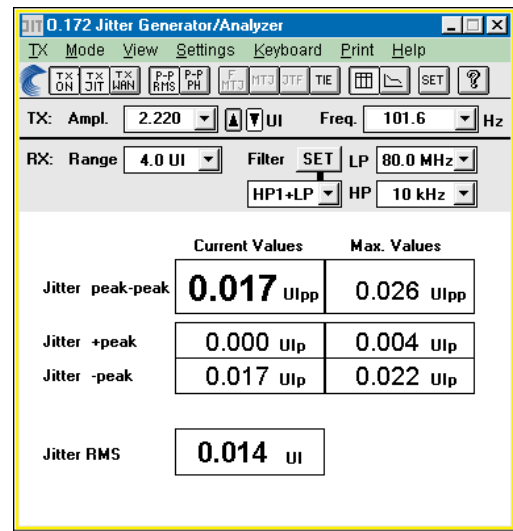


Figure 10: Jitter peak to peak/RMS measurement

### 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

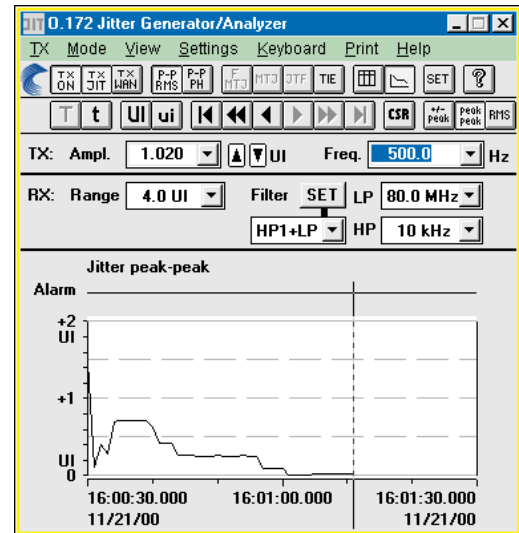


Figure 11: Jitter versus time display

### Jitter versus time (Figure 11)

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

### Clock jitter measurement

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

## RMS measurement

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

## Wander Analysis

### Time Interval Error (TIE)

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

MTIE is additionally determined as a continually updated numerical  
 value.

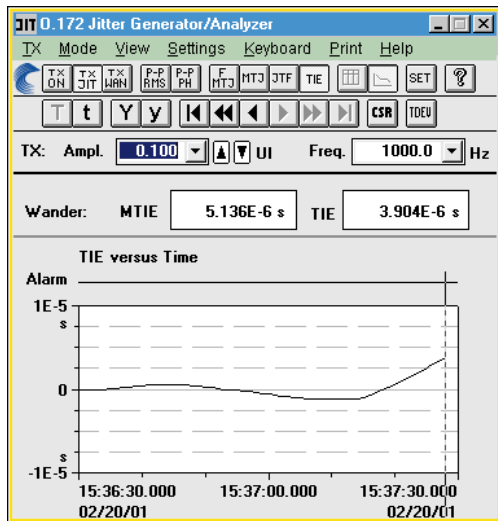


Figure 12: On-line wander testing (TIE)

To prevent data loss or premature termination of long term measurements, the ANT-10Gig checks the remaining space on the hard disk before the start of the measurement. If necessary, the selected measurement time can be adjusted.

The TIE values are recorded and are then available for subsequent off-line MTIE/TDEV evaluations. The values are also saved in .csv format for documentation or further analysis.

## MTIE/TDEV Off-line Analysis Evaluation

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

TIE values results obtained using the ANT-10Gig are analyzed according to ANSI T1.101, Telcordia GR-1244, ETSI ETS 300 462, EN 302 084, ITU-T O.172, G.810 to G.813.

Network synchronization quality is presented graphically using the MTIE (Maximum Time Interval Error) and TDEV (Time Deviation) parameters. To ensure correct assessment, the tolerance masks for PRC (Primary Reference Clock), SSU (Synchronization Supply Unit), SEC (Synchronous Equipment Clock) or PDH can be superimposed.

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

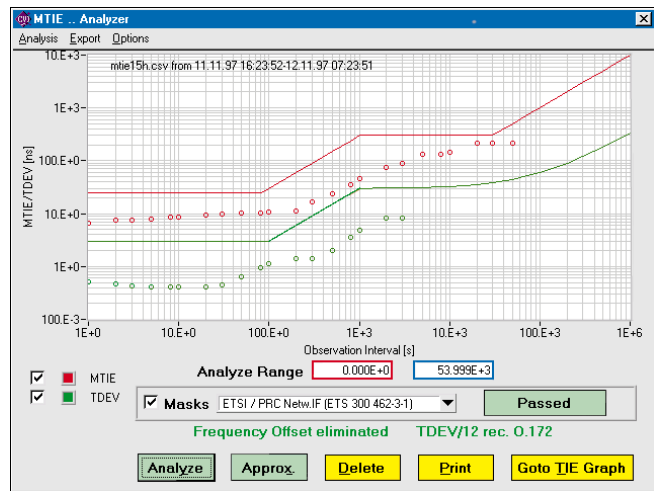


Figure 13: Display of MTIE/TDEV results and comparison against masks

This software allows several TIE results to be displayed simultaneously. Decisive details during long term measurements disappear in the multitude of results. An effective zoom function is available for detailed wander characteristic analysis.

### Result printout and export

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

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

To ensure reliable operation when a clock source is in holdover mode, the frequency characteristics must not exceed specific deviation limits relative to an absolute reference source.

To verify this data, the ANT-10Gig determines the following over the selected measurement interval:

Frequency offset ..... in ppm  
 Frequency drift rate ..... in ppm/s

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

If the reference is unavailable (too far away) when analyzing the wander of asynchronous signals, the MTIE analysis may have a superimposed frequency offset.

This offset depends on the difference between the signal and local reference clocks.

The MRTIE measurement subtracts the frequency offset from the result so that the “actual” wander characteristic is shown.

Accessory for wander analysis

Standard frequency source ..... see end of chapter

## Automatic Measurements

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

### Automatic determination of selective Jitter

#### Transfer Function, JTF

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

The Jitter Transfer Function indicates the ratio of the jitter amplitude at the output of the device under test to that at the input at various frequencies.

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

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

**Additional measurement mode**

– Transfer MTJ results:

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

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

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

**Freely programmable tolerance masks**

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

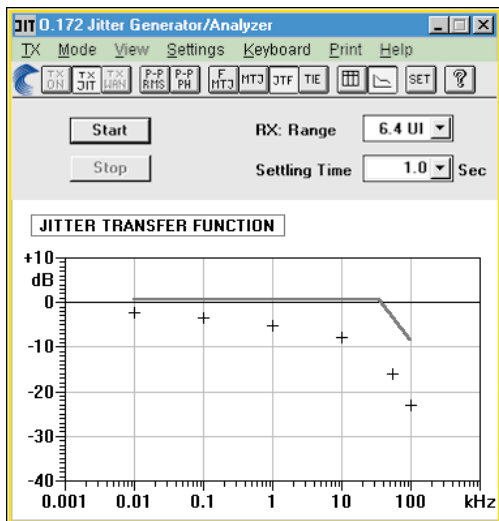


Figure 14: Jitter transfer testing results

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

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

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”.

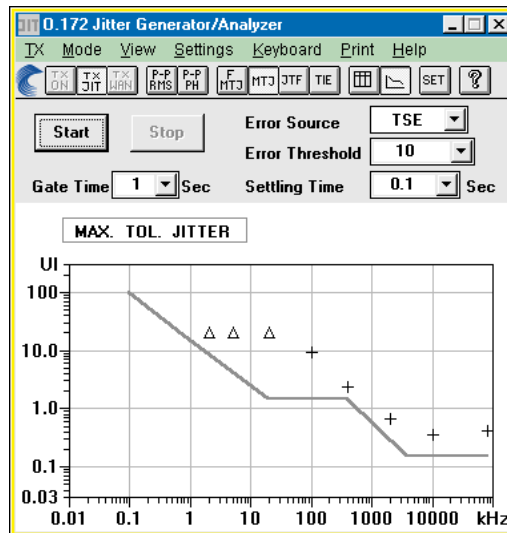


Figure 15: Maximum Tolerable Jitter testing

**Automatic determination of Maximum Tolerable Jitter, MTJ**

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

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

The maximum permissible jitter amplitude is determined precisely and quickly using a successive method.

The ANT-10Gig determines the exact limit value.

The method is derived from long experience in the performance of jitter tolerance tests and is recognized by leading systems manufacturers.

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

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

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

**Freely programmable tolerance masks**

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

**Automatic pointer sequences for analyzing combined jitter** (available with CATS Test Sequencer option)

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

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

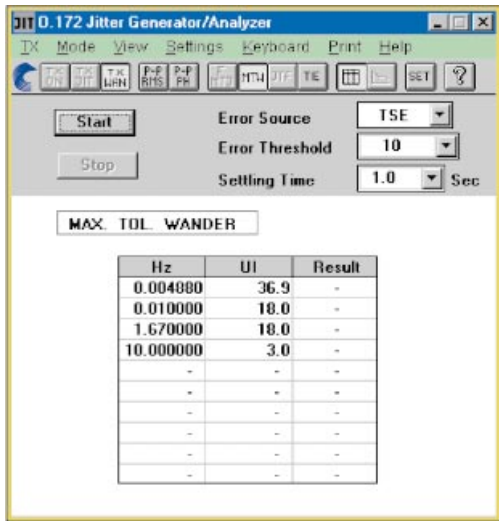


Figure 16: Maximum tolerable wander result display

**Automatic limit testing of  
Maximum Tolerable Wander, MTW**  
ITU-T G.823, G.824

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

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

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

## Accessory

**Acterna TSR-37  
Rubidium Timing Signal Reference**

**DA 3700/00**

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

Provides the reference clock for wander analysis using the ANT-10Gig.



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

See Acterna TSR-37 data sheet for details.

# ATM Options

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

## ATM Basic

BN 3060/90.50

### General

#### Adjustable test channel from 0 to 150 Mbit/s

In ATM network elements, user channels are monitored with the UPC (usage parameter control). The sensors of the control instance can be quickly checked if the bandwidth of a test channel exceeds the set threshold in the network element. For all measurements, the test channel in the ANT-10Gig is set on-line. Settings are made directly with a control (Figure 18) which shows the bandwidth in Mbit/s, Cells/s or %. This makes it easy to simulate CBR (Constant Bit Rate) sources.

For each interface, the load setting has a range from 0.01% to 100%. This corresponds to the load conditions which can occur in the real world.

#### Load profiles

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

#### Background load generator

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

#### Determining Cell Delay Variation

The ANT-10Gig includes very powerful tools for measuring delay parameters. Once a precise measurement has been made, subsequent measurements usually require only a low-resolution display to allow rapid pass/fail assessment. Delay values are displayed by the ATM Traffic Analyzer as a histogram with a minimum class width equal to 160 ns (maximum 335 ms).

As a result, delay fluctuations are shown graphically with the same resolution. An adjustable offset can be used to maintain measurement accuracy even if the delay values are high, e.g. over international links.

#### F4/F5 OAM alarm flow

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

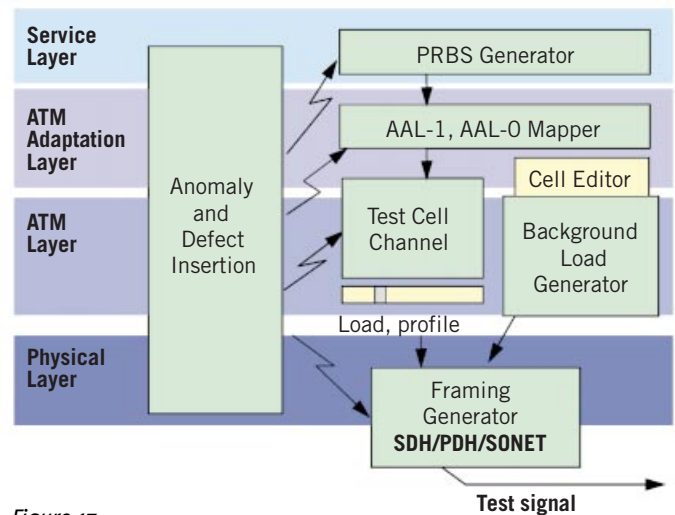


Figure 17: ATM-BERT generator configuration

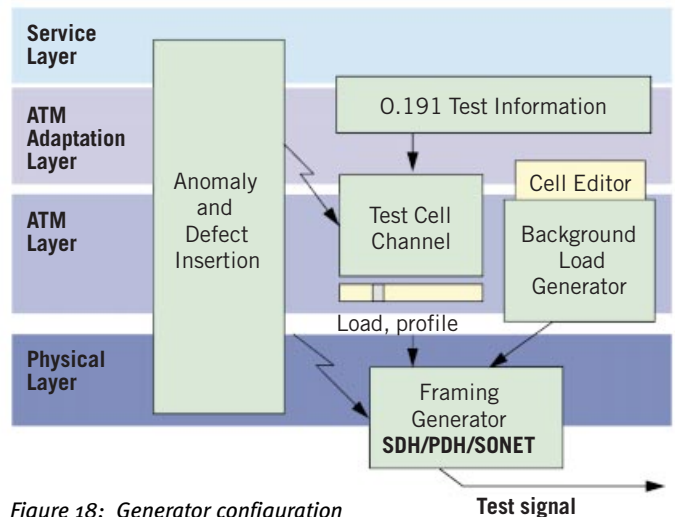


Figure 18: Generator configuration for performance measurement

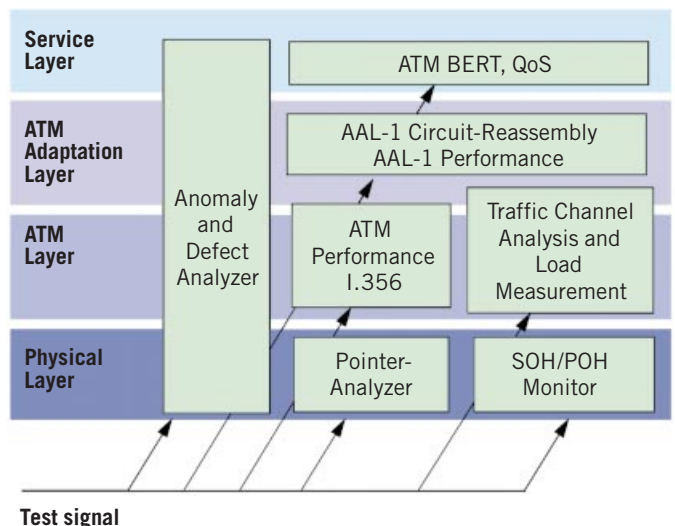


Figure 19: Analyzers in the ANT-10Gig - A hierarchical overview

## The ATM module comprises:

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

## Generator unit

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

## Test cell channel

Adjustable from ..... 0 to 149.760 Mbit/s  
Header setting ..... editor  
Load setting in ..... Mbit/s, Cells/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 10 000 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-10Gig basic instrument  
ATM layer, AAL:  
Correctable and non-correctable header errors  
- AAL-0, cell payload bit errors  
- AAL-1, sequence number errors  
- AAL-1, SAR-PDU bit errors  
- AAL-1 SNP, CRC errors  
- AAL-1 SNP, parity errors  
Triggering ..... single errors, error ratio,  
n errors in m cells

## Alarm generation

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

## Background load generator

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

## Circuit emulation

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

## Receiver unit

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

## Measurement types

### Error measurement (anomalies), statistics

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

### ATM performance analysis

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

### Alarm detection (defects)

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

### User channel analysis

Concurrent X-Y chart (load vs. time) for:  
- All user cells  
- Average cell rate of a selected cell channel  
- Peak cell rate of a selected cell channel  
Display units ..... Mbit/s, Cells/s, %  
Channel utilization histogram:  
- All user cells ("assigned cells")  
- A selected cell channel ("user cells")  
Cell distribution of a selected cell channel with classification by:  
- User cells  
- F5 OAM flow  
- F4 OAM flow  
- User cells with CLP=1

### Circuit reassembly

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

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

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

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

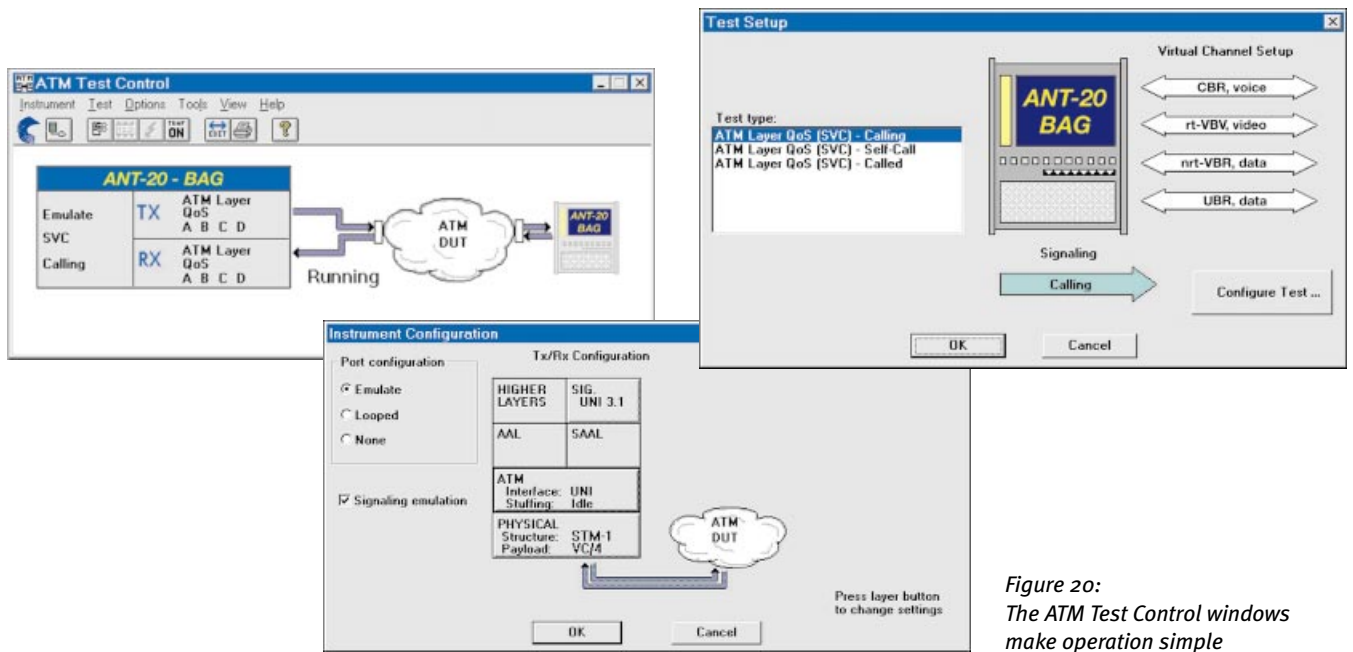


Figure 20: The ATM Test Control windows make operation simple

**Direct testing of all contract parameters**

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

For such applications, the Broadband Module includes an editor that permits all of the contract parameters for the various ATM services to be set for the first time.

For terminal emulation, all contract characteristics and of the traffic model used for the test can be defined with the Channel Editor.

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

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

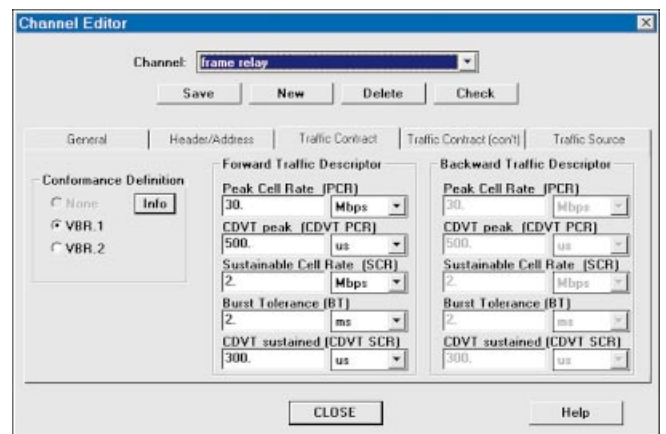


Figure 21: Channel Editor: Setting the traffic descriptor

### ATM QoS test with four different SVCs

The ANT-10Gig with BAG can perform SVC and PVC tests on up to four circuits simultaneously. Multi-channel services, such as those used for multimedia applications, can thus be simulated.

Any channel type can be selected from the database or newly defined for each channel.

Real-time measurements conform to the ITU-T O.191 standard which defines the test cell format and the test algorithm. Important source parameters can be regulated on-line during the test.

The results are clearly displayed, with graphics elements used to indicate defects or highlight status information.

### Signalling analysis

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

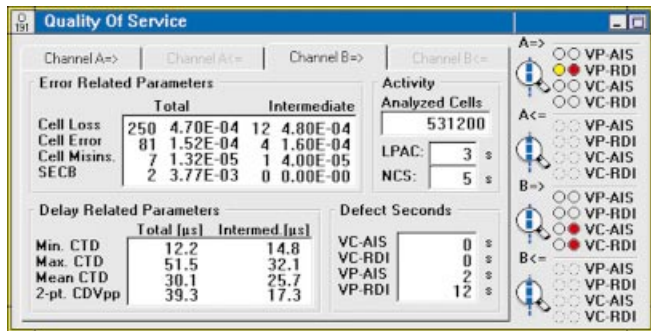


Figure 22: ATM test results for a real-time measurement on channel A

### 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.

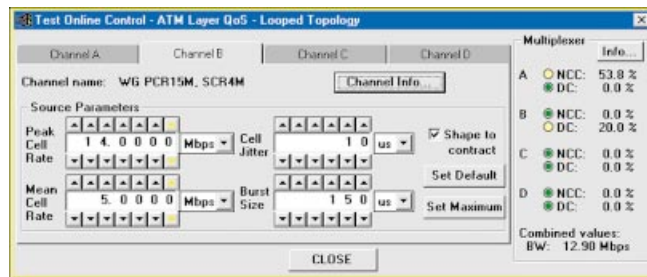


Figure 23: Soft-LED indication of multiplex results

### Professional record of results

The ANT-10Gig generates a professional record of instrument settings and test results that is output from a standard printer.

The record can be used for various purposes, e.g.:

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

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

## Broadband Analyzer/Generator

The module includes software test functions for

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

### ATM test controller

#### Instrument port configurations

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

#### Test cell channels

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

### ATM service categories

Switched circuits and permanent circuits for:

Constant Bit Rate ..... CBR  
 Real-time Variable Bit Rate ..... rt-VBR  
 Non real-time Variable Bit Rate ..... nrt-VBR  
 Deterministic Bit Rate ..... DBR  
 Statistical Bit Rate ..... SBR  
 Unspecified Bit Rate ..... UBR

### Signalling emulation

Terminal emulation at the UNI as per ITU-T and ATM Forum recommendations

Protocol types ..... UNI 3.0  
 ..... UNI 3.1  
 ..... Q.2931  
 ..... Q.2961

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



## ATM channel editor

Traffic contract:	
Direction type	unidirectional bi-directional asymmetrical, bi-directional asymmetrical
Traffic descriptor	
Peak Cell Rate	PCR
Cell Delay Variation Tolerance peak	CDVT peak
Sustainable Cell Rate	SCR
Burst Tolerance	BT
Cell Delay Variation Tolerance sustained	CDVT sustained
Source parameters	
	Cell clumping, Burst size Mean cell rate Peak cell rate

## On-line channel settings

Peak cell rate  
Cell clumping  
Mean cell rate  
Burst size

## Traffic management

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

## Error insertion

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

## Alarm generation

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

## ATM test results

### Measurement modes

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

### Receiver status (ISM, OOS)

Signal load, bandwidth  
Correctable and uncorrectable header errors  
Errored seconds . . . . . LCD, physical layer defects

### ATM Quality of Service (QoS) for 4 SVCs or 4 PVCs

- Cell error ratio
- Cell loss ratio
- Cell misinsertion rate
- Mean cell transfer delay
- Maximum cell transfer delay
- Minimum cell transfer delay
- 2-point cell delay variation
- Severely errored cell block ratio

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

## Alarm detection, defects (ISM, OOS)

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

## Signalling analysis

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

## ATM channel explorer (ISM, OOS)

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

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

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

## Add ATM SDH

**BN 3060/90.52**

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

The following ATM mappings are included:

### E4 (140 Mbit/s) ATM mapping

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

### E3 (34 Mbit/s) ATM mapping

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

### E1 (2 Mbit/s) ATM mapping

Bit rate . . . . . 2048 kbit/s

### STM-1/VC3 ATM mapping

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

## Add ATM SONET

**BN 3060/90.53**

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

The following ATM mappings are included:

### STS-1/STS-3 ATM mapping

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

## DS3 (45 Mbit/s) ATM mapping and STS-1 DS3 ATM mapping

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

## DS1 (1.5 Mbit/s) ATM mapping

Bit rate ..... 1544 kbit/s

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

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

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

### Test cell channel

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

### Test cells, payload 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  
Constant Bit Rate (CBR), setting range ..... 0.01 to 25%  
Variable Bit Rate (VBR), settings  
Peak cell rate ..... 1 to 25%  
Mean cell rate ..... 1 to 25%  
Burst size ..... 4 to 4092 cell times  
Burst period ..... 8 to 131 068 cell times

### Error insertion

Physical layer like basic ANT-10Gig instrument  
ATM layer, AAL:  
– Correctable and non-correctable header errors  
– AAL-0, cell payload bit error  
– AAL-1, sequence number error  
– AAL-1, SAR-PDU bit error  
– AAL-1 SNP, CRC error  
– AAL-1 SNP, parity error  
Resolution:  
Single error, error ratio, n errors in m cells

### Alarm generation

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

### Circuit emulation

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

### Error measurement, anomalies, statistics

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

### ATM performance analysis

– Cell error ratio  
– Cell loss ratio  
– Cell misinsertion rate  
– Mean cell transfer delay  
– 2-point cell delay variation  
Measured between greatest and smallest value of cell transfer delay  
– Cell transfer delay histogram:  
Number of classes ..... 128  
Min. class width ..... 160 ns  
Max. class width ..... 335 ms  
Adjustable offset ..... 0 to 167 ms  
Offset steps ..... 2.5  $\mu$ s

### Alarm detection, defects (ISM, OoS)

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

### Traffic channel analysis

Time chart simultaneously for  
– All traffic cells  
– Average cell rate of any selected cell channel  
– Peak cell rate of any selected cell channel  
Display in ..... Mbit/s, Cells/s, %

### Channel utilization histogram

– All assigned cells  
– One selected cell channel (user cells)

### Cell distribution in traffic channel

Classification of one selected cell channel by  
– User cells  
– F5 OAM flow  
– F4 OAM flow  
– User cells with CLP=1

### Circuit reassembly

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

# AUTO/Remote

## ANT-10Gig applications in the remote controlled production environment

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

Remote control of instrument functions using SCPI command structure  
Interface ..... V.24/RS232

### GPIO (PCMCIA) Remote Control Interface **BN 3035/92.10**

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

### TCP/IP Remote Control Interface **BN 3035/91.11**

Remote control of instrument functions using SCPI command structure  
Interface ..... 10/100 Mbit/s Ethernet

### LabWindows driver **BN 3035/95.99**

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

## Simplified test automation (Figure 24)

### Computer Aided Test Sequencer (CATS) and Test Case Library

The Test Sequencer is the ideal tool for rapid, simple adaptation and automatic performance of complete test sequences on the ANT-10Gig (CATS = Computer Aided Test Sequence). 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.

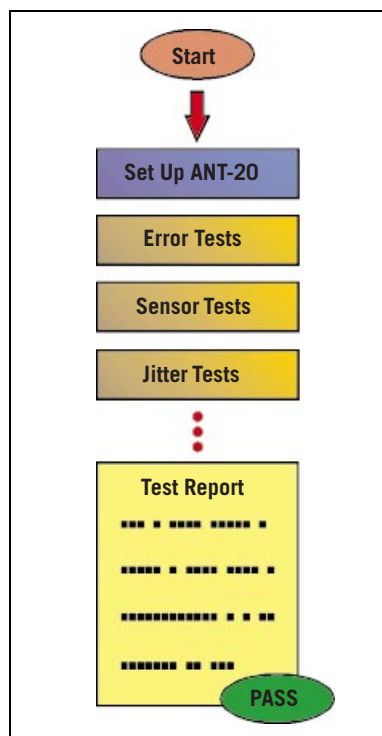


Figure 24: Automatic test sequences with the ANT-10Gig

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".

## Remote Operation **BN 3035/95.30**

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

### Remote Operation via the included Ethernet Interface and Remote Operation via Modem

Provides remote operation via a PCMCIA or external modem (V.24) which must be purchased separately.

## Calibration

### Calibration report

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

Recommended confirmation interval ..... 24 months

## Training courses

### ANT Training

"SDH/SONET Troubleshooting" **BN 3035/89.01**  
(Two-day interactive workshop on SDH/SONET basics in connection with important measurement applications and presentation of Acterna test solutions).

"Synchronization" **BN 3035/89.02**  
(Half-day interactive workshop on aspects of synchronization and typical measurement applications).

"Solving Jitter Problems" **BN 3035/89.03**  
(Half-day interactive workshop on jitter problems and presentation of Acterna test solutions).

"SDH/SONET Quality of Service" **BN 3035/89.04**  
(Half-day interactive workshop on performance measurements to G.821, G.826 and M.2100).

"Optimizing Your SDH/SONET Network" **BN 3035/89.05**  
(One-day interactive workshop on measurement applications and operation of the ANT-10Gig).

### Information via Internet

<http://www.ant-20.acterna.com>

# Ordering Information

## ANT-10Gig SDH version

**BN 3060/35**

Includes:

- Mainframe, touchscreen
- STM-64/OC-192 combined with STM-4c, STM-16c and STM-64c, STS-12c SPE, STS-48c SPE, STS-192c SPE
- Mappings for STM-1: DS1, E1, DS3, E3, E4
- Electrical interfaces: STM-1, E1, E3, E4
- APS, TCM analysis, OH capture, OH sequencing
- Two optical adaptors to be selected

## Options

### Electrical Interfaces at 9953 Mbit/s

Please order with the mainframe as a subsequent upgrade is not possible.

BN 3060/91.48

### Add SONET

STM-0 mappings  
STM-0 and VT2 SPE (2 Mbit/s)  
STM-0 and VT1.5 SPE g (1.5 Mbit/s)  
VT6 SPE (6 Mbit/s)  
STM-0 and STS-1 SPE (34/45 Mbit/s)  
BERT (1.5/6/45 Mbit/s)

BN 3060/90.03

### Add BERT SONET only

(interfaces 1.5/6/45 Mbit/s)

BN 3060/90.34

### Drop & Insert

BN 3060/90.10

### PDH 64k/140M MUX/DEMUX chain

BN 3060/90.11

### M13 MUX/DEMUX chain

BN 3060/90.12

### Optical Interfaces

Include two optical adaptors – please select.  
The following options BN 3060/91.01 to /91.12 are alternatives.

Optical STM-0/1, OC-1/3, 1310 nm	BN 3060/91.01
Optical STM-0/1, OC-1/3, 1310 & 1550 nm	BN 3060/91.02
Optical STM-0/1/4, OC-1/3/12, 1310 nm	BN 3060/91.11
Optical STM-0/1/4, OC-1/3/12, 1310 & 1550 nm	BN 3060/91.12
The options BN 3060/91.50 to /91.53 are alternatives.	
Optical STM-16/OC-48, 1310 nm	BN 3060/91.51
Optical STM-16/OC-48, 1550 nm	BN 3060/91.50
Optical STM-16/OC-48, 1310/1550 nm switchable	BN 3060/91.52

### STM-4c/OC-12c options

STM-4c/OC-12c ATM Testing Requires Optical Module BN 3060/91.11 or /91.12 and ATM BASIC BN 3060/90.50	BN 3060/90.91
STM-4c/OC-12c Virtual Concatenation Requires BN 3060/90.90 or /90.91	BN 3060/90.92

### Optical Packages

Include optical interfaces from 52 Mbit/s to 2488 Mbit/s and four optical adaptors – please select.

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

### Optical Attenuator (plug-in)

SC-PC, 1310 nm, 15 dB

BN 2060/00.61

### Optical Power Splitter (90%/10%)

Includes three optical adaptors – please select.

BN 3060/91.05

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

## ATM Functions

### ATM Basic for STM-1/STS-3c

BN 3060/90.50

### ATM Comprehensive

Includes ATM BASIC and BAG

BN 3060/90.51

### Add ATM SONET

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

### Add ATM SDH

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

### OC-12c/STM-4c ATM Testing

Requires Optical Module BN 3060/91.11 or /91.12

BN 3060/90.91

### Test Automation

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

### 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 3035/95.99

### Remote Operation

Remote Operation	BN 3035/95.30
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## Calibration report

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

BN 3060/94.01

## Accessories

Transport case for ANT-10Gig

BN 3035/92.03

External keyboard (UK/US)

BN 3035/92.04

Decoupler (-20 dB, 1.6/5.6 jack plug)

BN 3903/63

TKD-1 probe, 48 to 8500 kbit/s

BN 822/01

TSR-37 Rubidium Timing Source Reference

DA 3700/00

PenBERT mini PCM monitor (E1)

BN 4555/11

(see PenBERT data sheet for details)

## Training courses

Location: 72800 Eningen u.A., Germany

Information about availability and other locations available on request.

“SDH/SONET troubleshooting”

BN 3035/89.01

“Synchronization”

BN 3035/89.02

“Solving Jitter Problems”

BN 3035/89.03

“SDH/SONET Quality of Service”

BN 3035/89.04

“Optimizing Your SDH/SONET Network”

BN 3035/89.05