6 Appendix

Technical data for the electrical characteristics can be found on the next few pages.

6.1 Technical data

6.1.1 Electrical characteristics

Impedance

General data for transmitter:

Signal shape	Sinusoidal
Frequency range	2 kHz to 1 MHz
Frequency resolution	1 Hz
Frequency setting accuracy	± 2 Hz
Transmitted signal amplitude	U_{rms} = 100 mV to 300 mV
Transmit level accuracy	± 5 % of measured value
Output impedance	< 20 Ω

General data for receiver:

Frequency range	2 kHz to 1 MHz
Level resolution	12 bits
Receiver bandwidth	< 25 Hz

Output/input impedance:

Measured value indication	Level of impedance in curve form as a function of frequency
Frequency setting range	a) 2 kHz to 1 MHz b) 2 kHz to 40 kHz c) 10 kHz to 200 kHz d) 50 kHz to 1 MHz
Measuring range	100 Ω to 5 kΩ
Measuring error	< 5 % of measured value for 2 kHz ≤ f ≤ 300 kHz < 7 % of measured value for f > 300 kHz
Tolerance system	Fade-in as per CCITT I.430

Impedance of the active transmitter

Measured value display	Internal impedance of the active transmitter when transmitting binary "0".
Measuring range	15 Ω to 25 Ω
Measuring error	± 2 Ω

Unbalance

General data

Transmitted signal amplitude	700 mV to 1000 mV otherwise as for impedance measurement
Measured value display	Unbalance attenuation in curve form dependent on frequency
Frequency setting range	a) 2 kHz to 1 MHz b) 80 kHz to 1 MHz
Measuring range	38 dB to 78 dB
Insertion loss	2 kHz to 106 kHz a_e = 0.2 dB ±0.1 dB 106 kHz to 1 MHz a_e = 0.4 dB ±0.3 dB
Intrinsic unbalance	Up to 300 kHz > 74 dB, otherwise declining at 20 dB/dec
Measuring error	± 0.5dB of the measured value plus the intrinsic unbalance error
Tolerance system	Fade-in as per CCITT I.430

Transmitted signal pulse symmetry

Measured value display	a) numerical indication of the area unbalance b) amplitude unbalance of the 1st and 2nd double pulses
Measuring range	0 % to ± 10 %
Measuring error	a) Area ± 2.5 % b) Amplitude ± 2 %

Transmitted signal pulse shape

Measured value display	Graphic display of pulse shape dependent on time			
Input impedances	a) 5.6 Ω		± 0.16 Ω	
	b) 50 Ω		± 0.5 Ω	
	c) 400 Ω		± 4 Ω	
Measuring range, single pulse	a) -30 mV to	+210 mV at		5.6Ω
	b) -75 mV to	+825 mV at		50Ω
	c) -75 mV to	+2025 mV at		400Ω
Measuring range, double pulse	a) -225 mV to	+225 mV at		5.6Ω
	b) -825 mV to	+825 mV at		50Ω
	c) -2025 mV to	+2025 mV at		400Ω
Measuring error	a) ± 15 mV			
	b) ± 15 mV			
	c) ± 20 mV			
Level resolution	11 bits plus sign			
Time resolution	Double pulse = 3 * UI ÷ 256 ≅ 0.01 UI ≅ 62.5 ns			
	Single pulse = 2 * UI ÷ 256 ≅ 0.008 UI ≅ 41.7 ns			

Peak current

Measured value display	Numerical display of peak current value
Transmitted frequency	96 kHz, sinusoidal
Transmitted amplitude	Upp = 2.4 V [+ 0 % / - 4%]
Measuring range	0.1 mA to 1 mA
Measuring error	± 30µA for i ≤ 600 µA
	± 5 % of the measured value for i > 600 µA

Jitter (digital measuring mode in electrical characteristics menu)

Measured value display	Numerical display of jitter amplitude
Transmitted pattern	a) Binary "0" b) Binary "1" c) Alternating pattern "1"/"0AAhex", each in 40 frames d) PN pattern 2^{9}-1 e) PN pattern 2^{11}-1 f) PN pattern 2^{13}-1 g) PN pattern 2^{15}-1 h) PN pattern 2^{17}-1 i) PN pattern 2^{19}-1
Resolution	0.004 UI = 0.4 % UI
Resolution of display	In steps of 0.4% UI
Measuring range	0 to 0.5 UI = 50 % UI
Measuring error	a) TE 0.4 % UI b) NT 0.4 % UI + 2 % UI [self jitter]

Clock accuracy

Measured value display	Numerical display of frequency deviation
Measuring range	-200 ppm to +200 ppm
Measuring error	< 10 ppm
Measuring period	1 s, 5 s

Frame delay

Measured value display	Storing and numerical display of the min. and max. frame delay of a TE as well as continuous measured value output
Transmitted pattern	a) Binary "0" b) Binary "1" c) Alternating pattern "1"/"0AAhex", each in 40 frames d) PN pattern 2^{9}-1 e) PN pattern 2^{11}-1 f) PN pattern 2^{13}-1 g) PN pattern 2^{15}-1 h) PN pattern 2^{17}-1 i) PN pattern 2^{19}-1
Measuring range	± 1 UI = ± 100 % UI
Resolution	0.004 UI = 0.4 % UI
Resolution of display	In steps of 0.4% UI
Measuring error	0.006 UI = 0.6 % UI

K1403

Features

- Certified Conformance Tester for Layer of ISDN S_0 Interface
- Measurements on TE and NT in Accordance with ITU-T
- Testing of Functional and Procedural Characteristics
- Transmission Parameters and Power Feeding Measurements
- Trace Analysis of the TTCN Tests

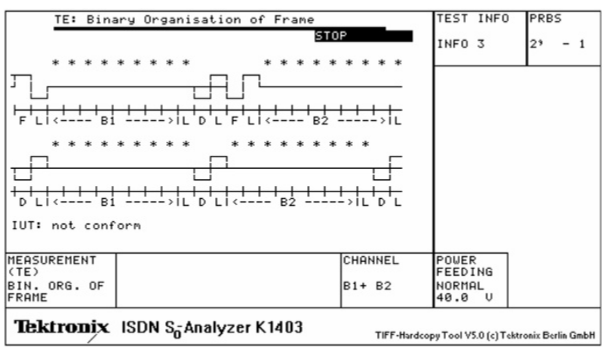


Figure 1. Presentation of result for binary organization of frame measurement.

The K1403 ISDN S_0 Analyzer is a test set for measurements on the S_0 bus. It is compact and equally suited for use in development and test departments as well as by maintenance personnel.

The K1403 is used to perform functional and procedural tests on TEs and NTs in order to verify that equipment conforms to ITU-T I.430. The K1403 is able to measure the receiver sensitivity by bit error testing on TEs and NTs.

The K1403 provides all the test facilities defined in the guidelines ITU-T I.430, ETS 300 012, CTS-2, NET3, and TBRs. Its modular design is expandable and adaptable to special measuring tasks. It combines all the modules, signals, auxiliary signals, and analyzers required for performing the measuring tasks into one compact instrument.

Measurement mode	Item under test	
	TE	NT
Measuring the transmission parameters		
Receiver sensitivity	X	X
Receiver input delay		X
Measuring the functional characteristics		
Basic interconnection tests	X	
Binary organization of frame	X	X
Interframe time fill	X	
D-echo channel response	X	
D-channel access control	X	
Activation/deactivation	X	
Timer tests	X	
Frame alignment procedure	X	
Multiframing procedure	X	
Idle channel code on the B-channel	X	
Measuring the power conditions		
Power consumption	X	
Output power		X
Current/transient measurement	X	
Current/time measurement	X	
Power-up tests	X	
Power-on/switchover tests	X	X
Power interruption	X	
Overload tests in restricted mode		X
Requirements on NTs of type "a"		X
Load variation tests		X
Options		
Transmission measurements	X	X
S_0 bus simulator	X	X
Jitter measurement/generation	X	X

Transmission Measurement Option

This option is used to expand the transmission measurement capability of the K1403. The electrical tests described in ITU-T I.430 and ETS 300 012 can thus be performed in their entirety.

Design and Mode of Operation

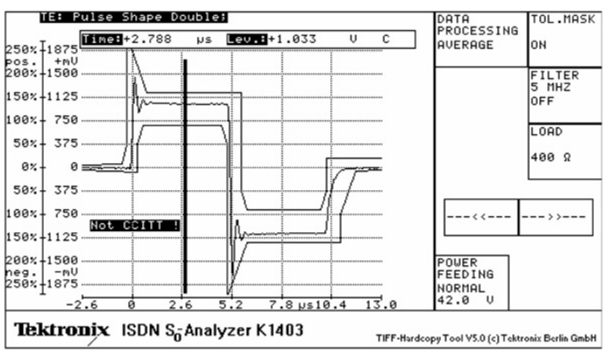
This option comprises three plug-in modules, Analog 1, Analog 2, and Jitter.

The Analog 1 Module is used to perform the impedance and balance measurement modes. It incorporates a synthesizer with high spurious signal suppression for generating the required sinusoidal signals in the range 2 kHz to 1 MHz under crystal control. The receiver operates selectively. The bandwidth is < 25 Hz and realized with a mechanical filter. The control panel allows the test modules to be coupled to the item under test. The control panel incorporates a relay switching panel as well as all the reference test items and instrument transformers.

Further analog measurements can be performed using the Analog 2 Module which incorporates the functions of a digital storage oscilloscope, a high-frequency counter, as well as various test pattern generators and detectors.

The plug-in jitter module accommodates two functional blocks. One of these blocks contains a phase jitter meter which evaluates the jitter in peak or RMS terms and displays the frequency components in spectral form. The other block generates jitter with an adjustable amplitude and frequency.

Figure 2. Presentation of results for pulse shape measurement.



Measurement mode	Item under test	
	TE	**NT**
Measuring the transmission parameters		
Impedance	X	X
Impedance for active transmitter	X	X
Unbalance	X	X
Transmit signal pulse balance	X	
Transmit signal pulse shape	X	X
Peak current	X	X

Frame delay	X	
Clock accuracy	X	
Jitter	X	X

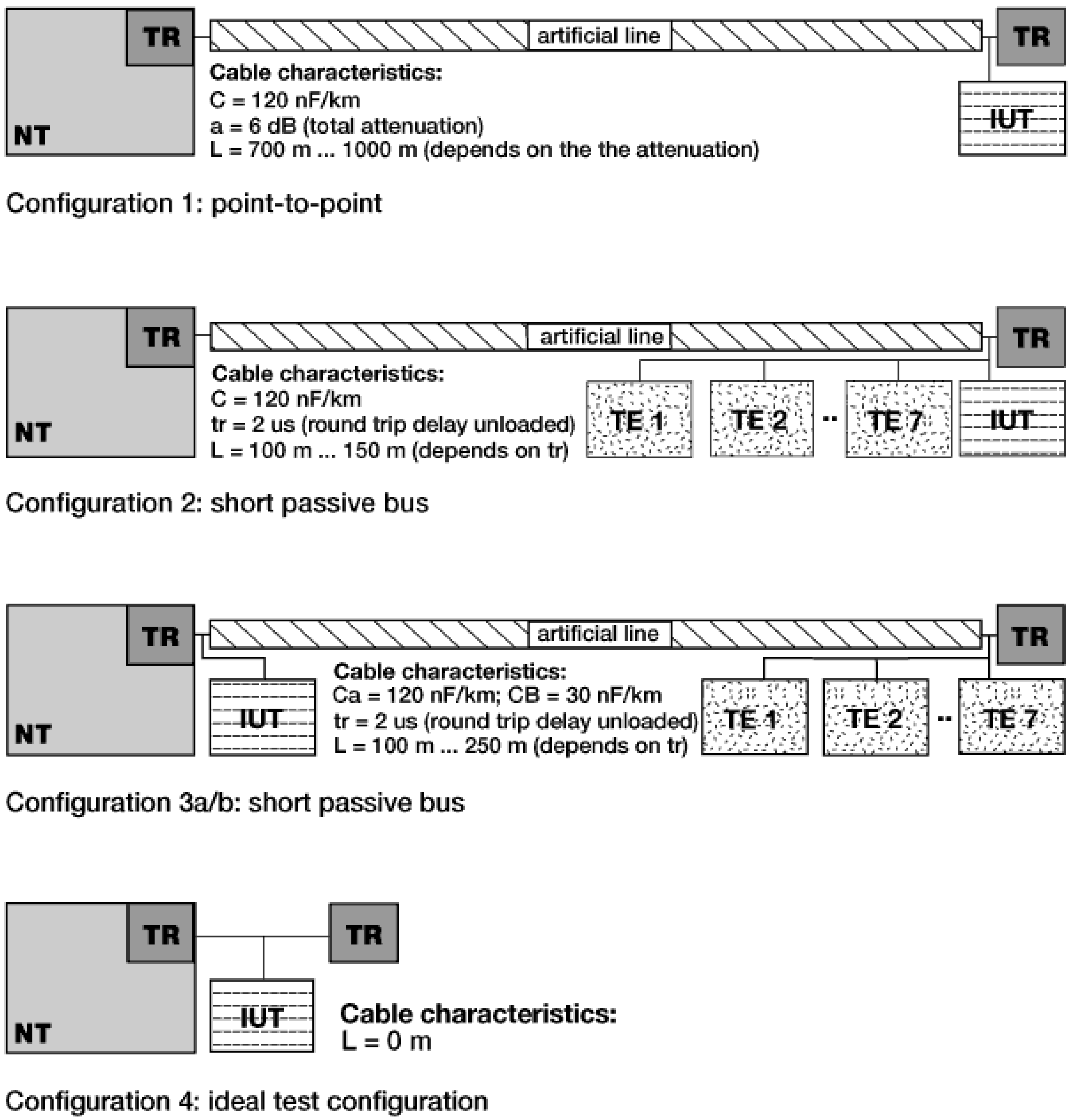
S_0 Bus Simulator Option

To measure the layer 1 characteristics of the terminal equipment (TE) or network terminations (NT) the international recommendation ITU-T I.430 calls for the use of an artificial line to simulate the "worst case" behavior of a line taking into account simulated TE loads, terminating resistors associated with the installation, and noise on the line.

Using the S_0 bus simulator as an option in the K1403 ISDN S_0 Analyzer, it is possible to check the functionality of the terminal equipment and network terminations taking into account the transmission medium without having to connect an additional unit.

Design and Mode of Operation

The S_0 bus simulator option comprises a number of cascaded modules, each simulating 50 m of cable. All the modules are of identical design and comprise a balanced network of closely toleranced passive components. This arrangement precisely simulates the attenuation, delay, and characteristic impedance of a cable over the frequency range from DC to 1 MHz. In addition to the line modules, the simulator incorporates a noise generator providing sinusoidal noise in accordance with ITU-T I.430. External noise signals can be injected via a BNC jack.



Fixed bus configurations as per ITU-T I.430

a) Configuration 1: Point-to-point, high-capacitance cable
System loss = 6 dB, L 750 m

b) Configuration 2: Short passive bus, high capacitance cable
Propacation delay = 2 ms, L 150 m, IUT with 7 TEs at end of line

c) Configuration 3a: Short passive bus, high-capacitance cable
Propagation delay = 2 ms, L 150 m, IUT at NT, 7 TEs at end of line

d) Configuration 3b): Short passive bus, low-capacitance cable
Propagation delay = 2 ms, L 150 m, IUT at NT, 7 TEs at end of line

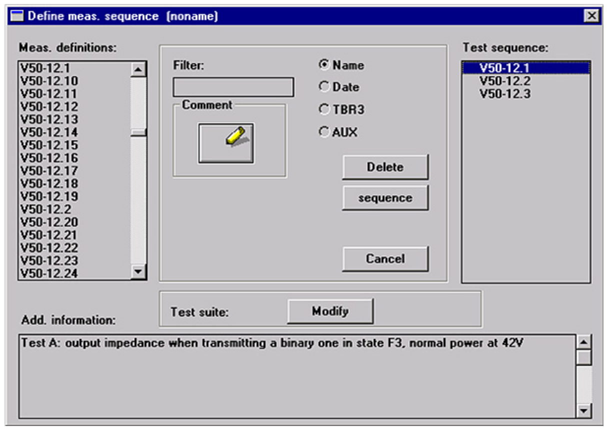
e) Configuration 4: Ideal
The line and TEs are switched off

Figure 3. Possible S_0 bus configurations.

The S_0 bus simulator is operated directly via the menu of the K1403. The touch screen is used to select the various bus configurations, noise injection circuits, terminating resistors and TE dummy loads before the actual measurement is performed.

PC Remote Control Software Option

Figure 4.



The PC remote control software permits convenient setting and control of the K1403 via the GPIB interface. Measurement and sequence settings can be stored for automating the tests.

This inexpensive "plug and go" Microsoft Windows program allows measurement results to be exported to other Windows applications for further processing.

Functionality

This package allows the user to set all relevant parameters for the TE measurement modes available on the K1403. Generated measurement settings can be saved, copied, and deleted after being named. The selection group "measurement settings" is subdivided into:

- Measurement settings as per CTS-2 or TBR3. Appropriate software libraries with the defined initial instrument settings are included in the package
- User-specific measurement settings. There are no restrictions on presetting user-specific measurements within the scope allowed by the K1403

The measurement modes at the TE are subdivided into the following measuring groups:

- Electrical characteristics
- Power conditions
- Functional tests
- Jitter measurements
- Bus simulation

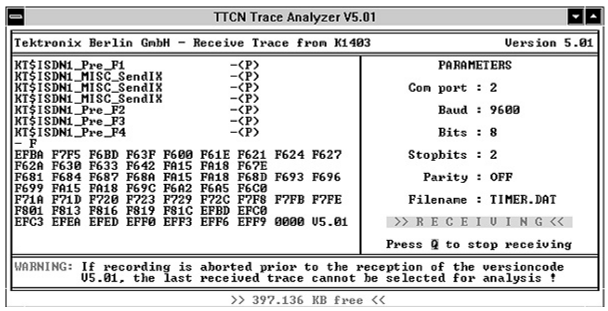
The software package allows the user to edit test sequences. The objects of the test sequences are the measurement settings. Generated test sequences can be saved, copied, and deleted after being named.

Depending on whether the "Tests as per CTS-2 or TBR3" or "General user-specific tests" function is selected, all measurement definitions are available for selection from one group or the other.

In addition to the name, it is possible to select the date and references to standards in order to facilitate searching for specific entries. A filter function allows the number of measurement definitions to be narrowed down, e.g., by entering partial qualifications to the search. The test sequence is assembled in a separate list in the form of measurement definitions.

Trace Analyzer Software Option

Figure 5.



After a functional test has been performed, the result is displayed on the K1403 as P for "passed", F for "failed", or I for "inconclusive". The Trace Analyzer Software presents the cause of the result in TTCN syntax.

Functionality

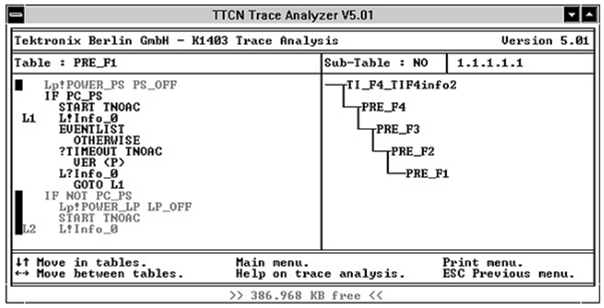
The commands from the K1403 and the response of the item under test are recorded in the K1403 during the functional tests. After the measurement, the data is transmitted via the V.24 interface to the PC with the aid of the trace analyzer software.

The main menu contains three windows. The data collected by the K1403 are presented on the left-hand side in hex format giving preamble tests. The name of the preamble test is followed by an entry for the relevant result (P/F). Displayed on the right is the parameter menu for the V.24 data transmission. Further menu options are set in the lower window, e.g., writing the receive data to a file.

The received hexadecimal data from the K1403 is compiled into a tree diagram.

The analysis menu also contains three windows. The left-hand window displays the data in TTCN syntax. The actual path being used is made visible by being displayed in a different color and identified by a vertical bar at the edge of the screen. This eases investigation in the event of a fault. The right-hand side shows the preamble tests. The lower window contains further menu settings such as help or print menus.

Figure 6. TTCN data analysis.



Either the TTCN table currently under investigation or a result indication showing the cause of the P/F/I verdict can be printed out.