

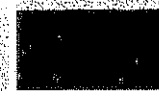
**SIEMENS**

**ISDN U Analyzer**

**K1404**

**14**

**04**





## ISDN U ANALYSER K1404

### Errors in the Software V 5.0:

#### **Funct. Charc. Frequency Shifting 2B1Q / Measurements on LT / So: ON**

- An upstream activation with a TE over the S0-bus of the K1404 is only possible once after switching on the K1404. Seldom there is shown no trace on the display.

#### **Funct. Charc. Frequency Shifting 2B1Q / Measurements on LT / So: OFF**

- Activating upstream with S0 Bus : OUT leads in very seldom cases to a suppression of the trace.

#### **Funct. board 2B1Q L330 plus Funct. board U<sub>P0</sub> L332**

- It is only an operation with **one** functional test board in the K1404 possible. Doing tests with the 2B1Q -Interface you have to pull out the U<sub>p0</sub> Interface board L332. Doing tests with the U<sub>p0</sub> Interface board L332 the U<sub>2B1Q</sub>-Interface board L330 can left behind in the K1404.

#### **Funct. Charc. Frequency Shifting U<sub>P0</sub> / Measurements on NT / So: ON**

- No upstream activation with the inbuild S<sub>0</sub>-Interface is possible
- BER via the inbuild S<sub>0</sub>-Interface is only possible with activation Loop 2.



**SIEMENS**

# **ISDN U Analyzer K1404**

Version 5.0

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User Manual

C73000-B6076-C173-3

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The product described in this manual complies with the statutory regulations on electromagnetic compatibility of devices (EMC) or the regulations of the guideline of the council from 03.05.1989 for adaptation of the statutory regulations of the member countries on electromagnetic compatibility of devices (89/336/EEC).

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# 1 About K1404

The ISDN-U-Analyzer K1404 by Siemens is a measuring device which allows you to perform measurements at the ISDN-U interface. You can activate both the ISDN component Network Terminator (NT) and the ISDN component Line Terminator (LT), and observe the operation set-up of layer 1.

It is possible to measure the electrical characteristics as well as the power feeding behaviour of the ISDN components. Functional tests and jitter measurements can also be carried out.

K1404 offers all test options defined by the CCITT G961, ANSI T1.601, ETSI ETR 080 and FTZ 1TR220 guidelines.

ISDN-U-Analyzer K1404 is a **compact test set** which combines in a single unit all the modules, signals, auxiliary signals and analyzers required for performing measurement tasks. The functions of the individual modules of the K1404 are coordinated by means of a powerful processor. Each module is controlled by its own microcomputer and is suited for a number of different measuring tasks.

K1404 features a built-in, **complete selective measuring station** with a frequency range of 500 Hz to 1 MHz. An exact analysis of the power spectrum density of the U signals is possible via selectable bandwidths (25 Hz or 2 kHz). The selective measuring device also supports the device-internal measuring bridges which are necessary for the determination of return loss and longitudinal unbalance at the U interface.

The transmission quality during operation can be determined via the display of a pseudo random signal. The display of specific bit errors is of course possible. In addition, power feeding characteristics may be analyzed using extensive variation possibilities.

The following table illustrates which measurements can be performed with ISDN-U-Analyzer K1404 in conjunction with the ISDN components NT and LT:

## Measurements of electrical characteristics

Return loss	NT	LT
Longitudinal unbalance	NT	LT
Longitudinal output voltage	NT	LT
Power spectral density	NT	LT
Total power	NT	LT
Noise voltage	NT	LT
Power feeding tests		
Power consumption	NT	
Power condition		LT
Switch-on test	NT	
Functional tests		
Activation/Deactivation	NT	LT
Bit error measurement	NT	LT
Clock accuracy	NT	LT
Jitter measurement	NT	

You may operate the ISDN-U-Analyzer K1404 either locally via menu or via remote control. An infrared touch-panel and a clearly structured menu guidance allow for **easy operation** in all measuring tasks. Functions and parameter settings are selected by simply touching the selection windows on the display.

The electroluminescent display with 256x512 image points allows you to display the results in either graphic or alphanumeric form. In the case of a graphic display, you can fade in tolerance lines. The measured results are evaluated such that no further processing is required. The displayed result structures can be printed and thus documented.

Remote control of the ISDN-U-Analyzer K1404 is effected via the built-in IEC bus (IEEE 488.2).

Due to its low total weight and its compact dimensions, the K1404 is easy to transport. A special transport case is available for safe transport.

## 1.1 About this manual

The present user manual contains a description of the ISDN-U-Analyzer K1404 as well as operating instructions for this device. Knowledge of the technical applications is prerequisite.

The introductory section which you are reading at present introduces the most important features of K1404. Please make sure to note the safety information at the end of this introduction.

Section 2, "Device Description" describes the hardware of the K1404. In section 3 "Start-up Preparations" you will learn how to make K1404 ready for use. Chapter 4 "Basic Functions" introduces the operating unit of K1404; it also tells you how measured results are loaded or saved.

Sections 5 through 8 introduce the various measuring modes that are possible with the K1404. Here, the relevant parameter settings for each measuring mode as well as the corresponding test set-ups and result structures are described.

Section 9, "Remote Control Operation" will tell you how to operate the K1404 via commands.

In the "Appendix" you will find the technical data of the K1404 and the installation of the V.24 printer interface is described. Here, you will also find a listing of the service offer as well as maintenance information.

The present manual uses the following **graphical conventions**:

"Messages"

from the system are given in quotes.

Font Courier

indicates menus, commands and parameters.

The arrow head (▶)

indicates instructions which are to be carried out.

Furthermore, the following symbols are used in the manual:



Additional information.

This information may be useful to you.



Warning!

This note is for your own safety and must be observed.

## 1.2 Safety information

The ISDN-U-Analyzer K1404 has been constructed and tested in accordance with IEC Publication 348, Safety Provisions for Electronic Measuring Equipment, and has left the factory in a perfectly safe condition. In order to maintain optimum safety and ensure hazard-free operation, the user must comply with the notes and warnings contained in these instructions.

- Transport the device only in its original packing or by using the transport case specially recommended for the K1404. This will protect the device against shocks.
- The K1404 is exclusively intended for indoor use. Condensation may occur when the unit is brought to its site of operation from a cold environment. Operation is only permissible with an absolutely dry unit after its temperature has adjusted to the environment.
- Before implementing and operating the K1404 make sure that the environmental conditions are complied with. The environmental conditions are listed under the heading "Technical Data" in the Appendix.
- Before switching on the device make sure that the preset operating voltage of the device corresponds to the admissible line voltage.
- Make sure that replacement fuses are of the specified type and rating: Use 3.15A/250 V (type T) fuses.
- The power plug must only be fitted into an earthed socket. Do not cancel the protective effect by using an extension cable without a protective earth conductor.
- Make sure that the ventilation slots on the rear and top of the device are not covered.
- The unit can become dangerous if the protective earth conductor is loosened and whenever the protective earth conductor is interrupted either inside or outside the unit. Do not interrupt the protective earth conductor intentionally. Particular caution is also imperative when the protective earth connector is to be disconnected. When opening covers or removing parts, remember that live parts may be exposed if the unit is connected.
- Connection points may also be live. Disconnect the unit from all voltage sources prior to adjustment, maintenance, repair or when replacing parts. If such work on live and open units cannot be avoided, it should only be performed by qualified staff familiar with the hazard involved.
- All modules contain electro-sensitive components. Please note the necessary precautions and ESD safety measures:



**Danger!**

Device-internal ground and the housing are connected with the protective ground. Voltages of up to 120 V DC may be present at the measuring sockets U at the front side and between the measuring sockets U and the sockets U1 and U2 at the rear of the device.

Safety sockets serve as protection against unintentional contact with these voltages.

**Warning!**

When electrical devices are in operation certain parts of these device are live. Non-observance of the above precautions may therefore lead to severe physical injuries or to serious material damage.

Only qualified staff may handle this device or work in its vicinity. This staff must be thoroughly familiar with all the warnings, safety and maintenance information contained in these instructions. Faultless and safe operation of the device presupposes proper transport, proper storage, set-up and mounting as well as careful handling and servicing.



## 2 Device description

The ISDN-U-Analyzer K1404 consists of a basic unit, several analysis modules which can be applied in various combinations, the CPU main processor, as well as the operating unit and the power supply unit. Owing to its modular design, K1404 may be individually fitted for its intended use.

## 2.1 Basic unit

The basic unit consists of the housing and the base plate. The following electrical components are mounted to the housing.

### Housing

- Combination filter/Switch W73041-E5500-K1: It includes mains socket, mains filter, mains switch and fuses. Mains switch and fuses affect both poles (phase and directly earthed conductor). The housing is earthed (central earthable point) directly via the mains socket. Bowden cable connects the tracer on the front panel with the mains switch of the combination filter.
- Switched-mode power supply W43048-A2001: The power supply unit (primary side) and combination filter are directly connected via two lines (blue/black). A yellow/green line connects the switched-mode power supply unit to the central earthing point
- Basic wiring C73249-A11-L37: Cable bundles with self-arresting plug-in connectors conduct the direct voltages of the power supply unit to the baseplate.
- Fan C73249-A11-B11: Corresponding plug-in contacts are located on the baseplate.
- Earthing socket in the front area: The socket is connected to the central earthing point.
- Power board C73249-A11-L111: For reasons of heat discharge, this module is mounted near the fan on the cover of the power supply unit. The module C73249-A11-L110 (feeding conditions) is electrically connected via a cable bundle with self-arresting plug-in connectors.
- Operating unit C73249-A11-L13: The operating unit is connected to the module C73249-A11-L12 (Main-CPU) via two plug-in band cables.

### Baseplate

The baseplate C73249-A11-L37 can support a maximum of eight modules. Slots for the following modules are available:

Measuring panel module (C73249-A11-L31)	Slot 1
Analog1 module (C73249-A11-L80)	Slot 2
(Reserve)	Slot 3
2B1Q module for functional tests (C73249-A11-L330)	Slot 4
4B3T module for functional tests (C73249-A11-L331)	Slot 5
Jitter module (C73249-A11-L30)	Slot 6
Module for power feeding test (C73249-A11-L110)	Slot 7
Main CPU (C73249-A11-L12)	Slot 8

The main function of the baseplate is the electrical network (data bus, power supply, signal-branching etc.) of the above-mentioned modules. The baseplate also supports and connects the measuring device sockets at the front of the K1404, i.e. the U sockets, EXTERNAL LINE sockets and BNC sockets B-IN, B-OUT, CLK and FSC, to the corresponding modules.



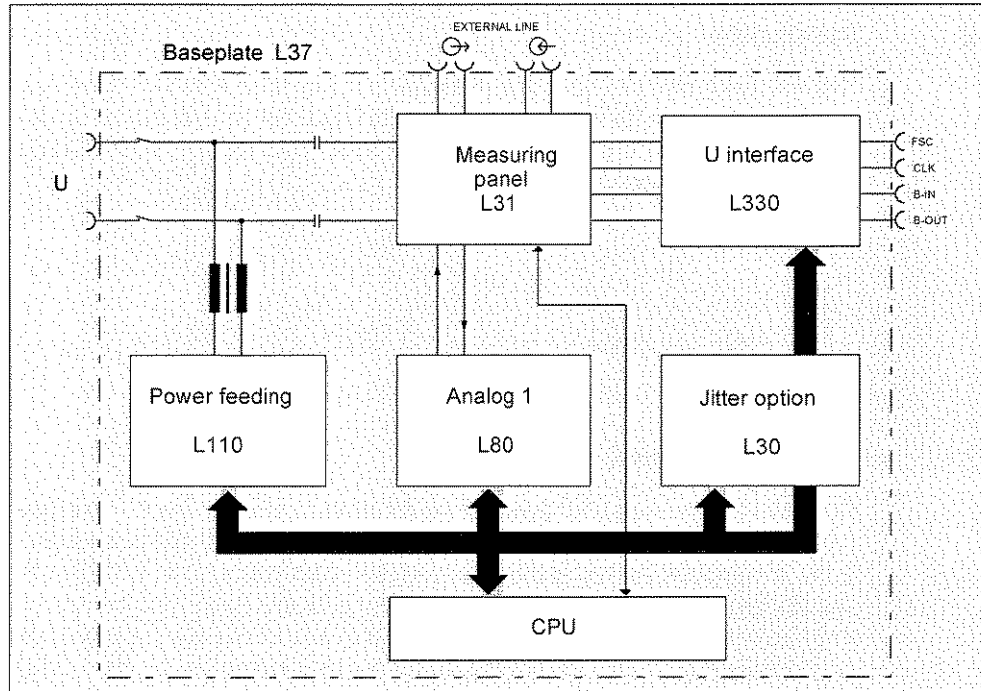


Fig. 2.1: Electrical network of the modules on the baseplate

Between the module Power Feeding Tests and the "U" sockets is the feeding choke. The choke can be bridged via a relay for analyses of loading and feeding behaviour.

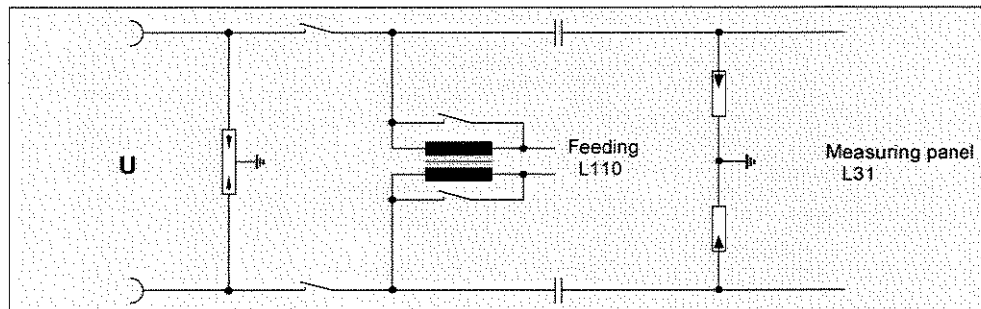


Fig. 2.2: Power Feeding Connection

The U interface is especially protected. Safety sockets protect against contact with the high feeding voltages. High-quality coupling capacitors protect sensitive parts of the measuring device against the supply voltage.

Voltage arresters (230V) placed directly at the U sockets and arresters (90V) placed after the coupling capacitors divert high voltage peaks to the housing (earth potential). In the event of a power failure (in the range of the measuring device) a monostable relay automatically cuts off the measuring device K1404 from the U interface.

## 2.2 Modules

The following components are available for use with K1404: measuring panel module, analog1 module, modules 2B1Q, 4B3T and Up for functional tests, jitter module, module for power feeding tests and the main processor unit. A description of these components is given below.



Only two of the modules 2B1Q, 4B3T and Up can be plugged in simultaneously.

### 2.2.1 Measuring panel module

The measuring panel module connects among others the U measuring socket (U interface) to the following modules: Analog1, 2B1Q and 4B3T modules for functional tests, module for power feeding as well as jitter module. In addition, the measuring signals for the following modules are conditioned such by attenuators, decoupling amplifiers and filters that a reliable analysis of the measuring signal can be carried out. Measuring bridges determine exact measured values for the evaluation of return loss and unbalance of the device under test.

The measuring panel module has the following design:

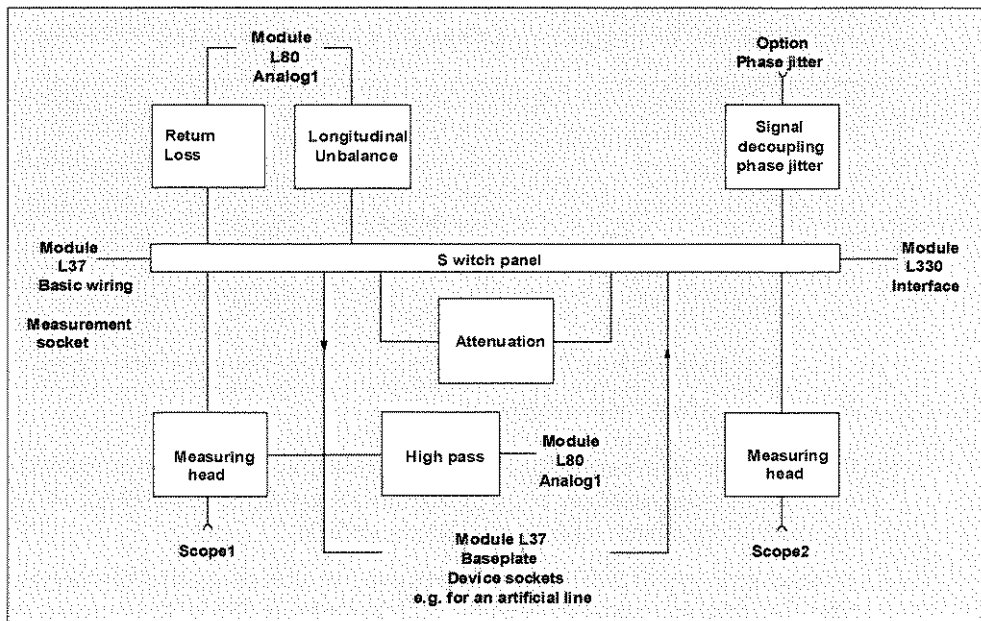


Fig. 2.3: Design of the device

The switch panel which consists exclusively of relays is laid out across the plug-in module. The part of the switch panel directly next to the U interface as well as the corresponding trigger circuit are isolated against device-internal ground and earth potential. Symmetrical attenuators that can be switched between 135 and 150 Ω are built into this part, too.

The switch panel also makes it possible to loop through external measurement aids (e.g. artificial lines) in the preset measuring system of the K1404. The measuring bridge, a differential transformer, may be used for the measurement of return loss and unbalance via the switchable measuring system.

When measuring **return loss**, an internal resistance reference is compared to the impedance of the device under test. The transmitter of the L80 module (Analog 1) feeds the differential transformer via a wide-band driver amplifier. A further transmitter decouples the bridge voltage proportional to return loss, so that the subsequent L80 module can carry out the evaluation.

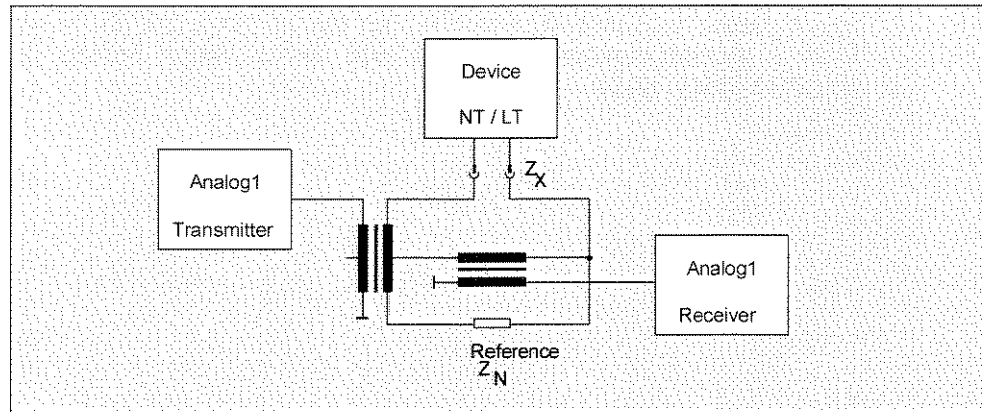


Fig. 2.4: Principle of return loss measurement

$$\text{Formula: } a_r = 20 \cdot \lg \left| \frac{Z_N - Z_X}{Z_N + Z_X} \right|$$

When measuring **longitudinal unbalance**, the device under test is applied to the primary side of the high symmetry differential transformer. The transmission signal is fed via the center tap. The secondary winding decouples the measuring voltage, a measure for unbalance, so that the L80 module (Analog1) can carry out the evaluation.

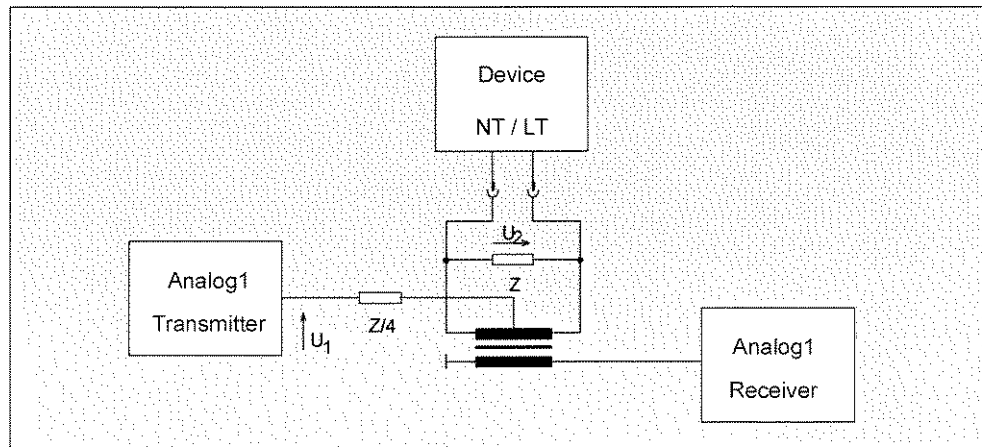


Fig. 2.5: Principle of longitudinal unbalance measurement

$$\text{Formula: } a_s = 20 \cdot \lg \left| \frac{U_1}{U_2} \right|$$

The L80 module carries out the **power spectrum density analysis** of the U interface components. The "measuring head", however, is located on the measuring panel near the U measuring sockets. It consists of a voltage divider, a differential amplifier and a driver stage. The differential amplifier converts the symmetrical input signal of the U interface to a coaxial output signal. A high pass which is switchable in the measuring branch increases the measurement dynamics and thus the accuracy of the measured results.

Connectable **measuring outputs** offer options for monitoring for external measuring devices. For example, the signal can be observed during operation simultaneously before and after a looped through attenuation or a looped-through artificial line using any standard 2-channel oscilloscope. For this purpose, the measuring panel features a second measuring head as well as the output sockets SCOPE1 and SCOPE2 (BNC / 50  $\Omega$ ).

## 2.2.2 Module Analog1

The module Analog1 (C73249-A11-L80) together with the measuring panel module permits the measurement of longitudinal unbalance, return loss, longitudinal output attenuation, power spectrum density and total power at the U Interface of ISDN LTs and NTs as defined in ETSI ETR 080 and ANSI T1.601.

The plug-in module contains three function blocks. The first function block contains a selective voltmeter (level meter) for the frequency range 1 kHz to 1 MHz. The second function block contains a tracking signal generator (level source) with an output frequency of 1 kHz to 1 MHz. The third function block contains a single-loop synthesizer and the frequency conditioner for conversion of the frequency in the receiver and transmitter. The function blocks are controlled by a processor on the module which also handles data transfer and the processing of measured values.

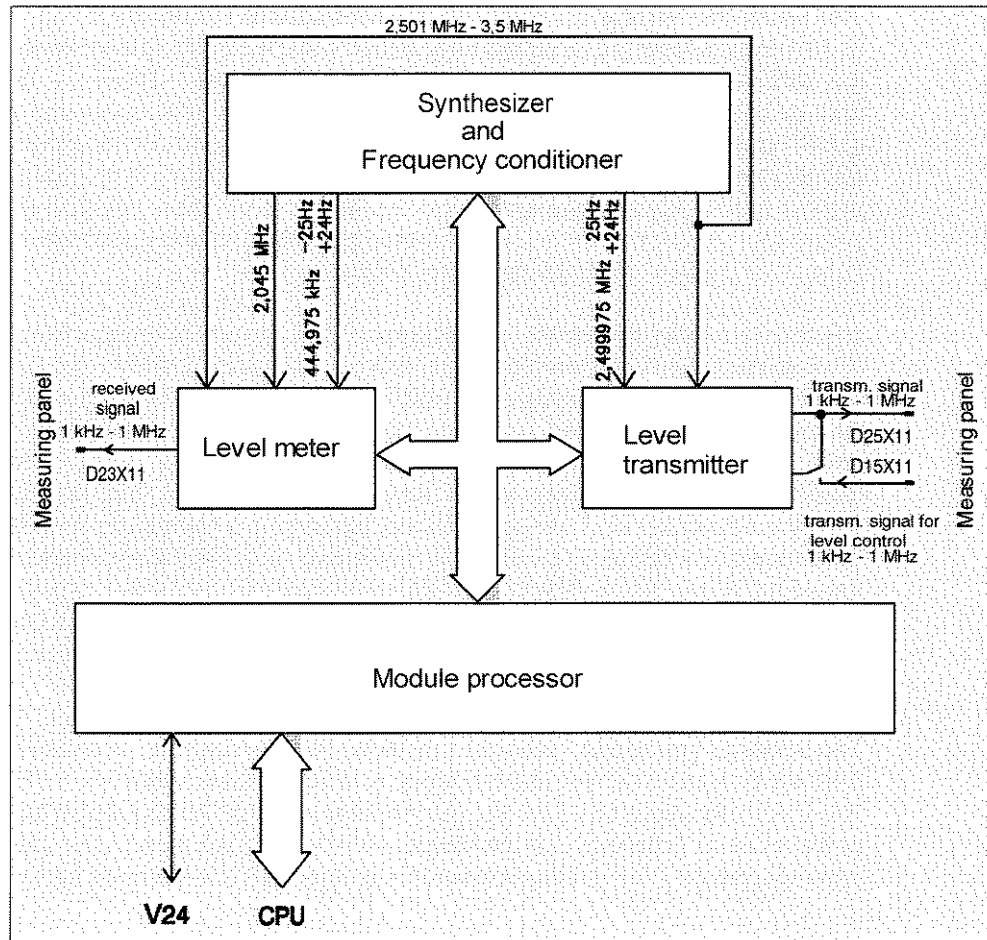


Fig. 2.6: Block diagram

The **level meter** operates according to the heterodyne principle. The signal from the measuring panel is matched in a preamplifier with multi-stage 12-dB level dividers to the input of the first mixer and boosted to a frequency of 2.5 MHz. The signal is mixed down to 10 kHz by means of two further conversions and limited in this frequency range to a bandwidth of 25 Hz by a switchable mechanical bandpass. The bandwidth of 2 kHz is realized via a mechanical filter in the 455 kHz intermediate frequency and a coil filter in the 10 kHz intermediate frequency. The signal is then amplified by an amplifier adjustable in steps of 6dB, rectified linearly into a quasi-rms value and then evaluated by a 12-bit A/D converter. The result from the setting of the level divider, the adjustable amplifier, and the evaluation by the A/D converter is processed in the module processor according to the application and transferred together with the frequency information to the main processor for output on the display.

The **level transmitter** operates as a beat-frequency transmitter with a signal frequency of 2.5 MHz and a mixed frequency of 2.5 to 3.5 MHz and serves as the signal source for return loss and longitudinal balance measurements. Its output frequency of 2 kHz to 1 MHz is amplified and applied to the measuring panel as the signal source for the return loss and longitudinal balance measurements. To regulate the amplitude, the transmitted signal is rectified linearly and applied via a comparator to the control transistor in the 2.5-MHz signal path. The transmitted level is set on the comparator by a D/A converter according to a setpoint/actual-value comparison to the level appropriate for the application.

**Synthesizer and frequency conditioner:** The 2 kHz reference frequency of the synthesizer is derived from a temperature-compensated 5 MHz crystal oscillator and boosted in a PLL to a frequency of 100 MHz to 140 MHz. The boosted frequency of the single-loop synthesizer is divided in the transmitter and receiver mixer into 2.5 MHz to 3.5 MHz for frequency conversion. A 50 Hz division at the converters is derived from the 2 kHz division in the upper frequency range (100 MHz to 140 MHz). The fine resolution of 1 Hz is achieved by pulling a temperature-compensated 5-MHz crystal oscillator. The pulling is monitored by a frequency counter. The signal frequency of the transmitter and the third conversion frequency of the receiver are derived from this oscillator by frequency division and mixing. Another oscillator, whose frequency is derived via a PLL from the 5 MHz crystal oscillator, is used as the basis for the mixing frequency of the second mixer.

The **module processor** controls the three function blocks, evaluates the results, processes these, and delivers the result to the main processor via a FIFO interface. The main processor transfers the information required for the respective application to the module processor via the same interface. In addition to the interface to the main processor, the module processor has another V.24 interface for test purposes.

### 2.2.3 Module 2B1Q for functional tests

The module 2B1Q carries out the functional tests (C73249-A11-L330). Its main function is providing an ISDN U interface for the line code 2B1Q. The module forms the counterpart to each device under test, operating either as LT or as NT. In addition, the module provides the precondition to read data in and out of the B channels (B1, B2 or (B1+B2)). In this way it is possible to recognize and evaluate errors of the components to be tested when transmitting data. It is also possible to monitor the monitor and the B\* channel by reading out the data content.



Functional tests may be performed with different combinations of modules: either 2B1Q or 4B3T or Up or 2B1Q and 4B3T or 2B1Q and Up or 4B3T and Up.

The plug-in module includes a complete LT (without feeding), switchable to NT (without load), a clock conditioning, a B /D channel multiplexer, a modified S<sub>0</sub> interface and a module processor.

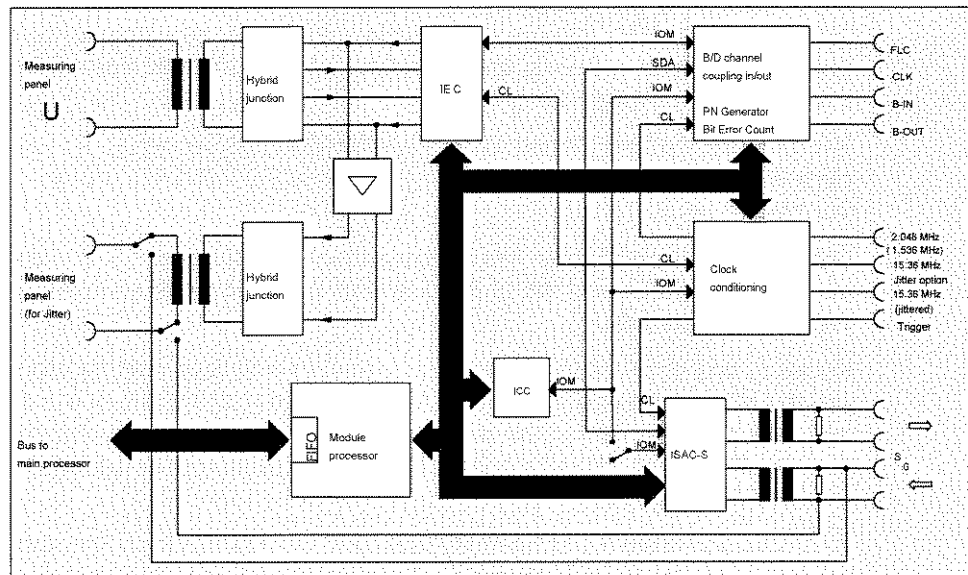


Fig. 2.7: Block diagram of the Functional Tests module

The LT / NT consists of an ISDN Communication Controller (ICC), an ISDN Echo Celler (IEC), a termination set (hybrid junction) and a symmetrical U transmitter.

The IEC-Q (PEP 2091) is controlled by the ICC (PEP 2070), the commands (enable, activate, deactivate, test loops etc.) are transmitted to the ICC via the module processor. Communication between the ICC and the IEC takes place via the ISDN oriented modular interface (IOM interface).

The IOM interface is a four-wire interface with the following signals:

- FSC Framesync (IOM frame clock 8 kHz)
- DCL Dataclock: (512 kHz = double bit clock)
- DIN Data Input: (stepping rate: 256 kBit/s)
- DOUT Data Output: (stepping rate: 256 kBit/s)

The transmission and reception signals of layer 1, which are separated at the IEC, are merged by a termination set and conducted via the symmetrical transmitter to the U interface. The U interface of the module is connected to the U sockets at the front of the K1404 via the measuring panel and the basic wiring (here the power feeding or the load are also connected). With the aid of a decoupling amplifier, a further termination set and a second transmitter, the transmission signal of the IEC is fed separately to the measuring panel and can be observed via an oscilloscope output.

**Clock conditioning** can be divided into three main groups: master clock generation, super framemaker generation and super framemaker recognition. The master clock of 15.36 MHz is generated by an LC oscillator which is synchronized via a PLL to a reference clock of 1.28 MHz. The reference clock of 1.28 MHz is gained with the aid of a direct digital synthesis (DDS) from an crystal oscillator. There is also the possibility to synchronize the reference clock of 1.28 MHz using another PLL to a system clock of 2.048 MHz or 1.536 MHz.

When the IEC-Q is used as LT, a super framemaker can be impressed on its IOM interface. This is used on the module to have the super framemaker available as a trigger signal (U frame trigger). The super framemaker is generated in the super framemaker generation.

When the IEC-Q is used as NT, the super framemaker received on the U side can be output to the IOM interface. To maintain the super framemaker as trigger signal even in this operating mode, the super framemaker must be detected with the aid of the super framemaker recognition.

The U clock (80 kHz), which is also available as trigger signal, as well as the IOM clock DCL (512 kHz) and the IOM frame clock FSC (8 kHz) are also derived from the master clock.

**B/D channel multiplexer:** The coupling and decoupling of the B channel data, the monitor information and the D channel and command/indicate data are carried out via the IOM interface.

Coupling and decoupling of the data is realised with four shift registers each to adjust the stepping rate of 64 Bit/s or 128 Bit/s to the 256 kBit/s of the IOM. The shift registers are controlled via an EPLD. Data determined for the B channels are generated by an internal PN generator. External data via the B-IN socket at the front can also be interconnected.

In return, the read-out B channel data can be distributed to the internal bit error counter or to the B-OUT socket for an external analysis. The frame and synchronization clock (FSC) and the data clock (CLK) are present at the corresponding sockets as a reference.

**Modified S<sub>0</sub> interface:** This interface consists of the ISAC-S (PEP 2086) module and two symmetrical S<sub>0</sub> transmitters as well as one ICC. The interface operates locally fed in the TE mode without load, and in the NT mode without feeding. The ISAC-S receives the commands via the module processor.

In addition, the receiver input of the S<sub>0</sub> interface can be switched over for phase jitter measurements via a relay at the corresponding output.

The **module processor** assures the control and communication of the individual components among each other, evaluates the measured results, processes these and sends the result via a FIFO interface to the main processor. This interface is also used to transmit information required for each measuring task to the module processor. Beside the FIFO interface to the main processor, the module processor also provides a V.24 interface for testing purposes.



## 2.2.4 Module 4B3T for functional tests

The module 4B3T carries out the functional tests (C73249-A11-L331). Its main function is providing an ISDN U interface for the line code 4B3T. The module forms the counterpart to each device under test operating either as LT or as NT. In addition, the module provides the precondition to read data in and out of the B channels (B1, B2 or (B1+B2)). In this way it is possible to recognize and evaluate errors of the components to be tested when transmitting data. It is also possible to monitor the monitor and the B\* channel by reading out the data content.



Functional tests may be performed with different combinations of modules: either 2B1Q or 4B3T or Up or 2B1Q and 4B3T or 2B1Q and Up or 4B3T and Up.

The plug-in module includes a complete LT (without feeding), switchable to NT (without load), a clock conditioning, a B/D channel multiplexer, a modified  $S_0$  interface and a module processor.

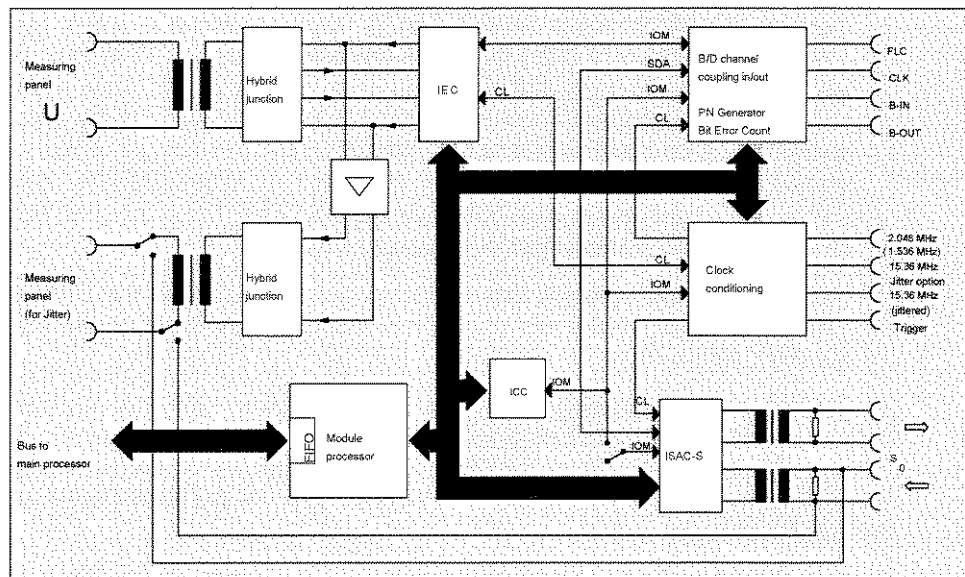


Fig. 2.8: Block diagram of the module Functional Tests

The LT / NT consists of an ISDN Communication Controller (ICC), an ISDN Echo Canceller (IEC), a termination set, the hybrid junction and a symmetrical U transmitter.

The IEC-T (PEP 2091/PEP 20902) is controlled by the ICC (PEP 2070), the commands (enable, activate, deactivate, test loops etc.) are transmitted to the ICC via the module processor. Communication between the ICC and the IEC takes place via the ISDN oriented modular interface (IOM interface).

The IOM interface is a four-wire interface with the following signals:

- FSC     Framesync     (IOM frame clock 8 kHz)
- DCL     Dataclock:     (512 kHz = double bit clock)
- DIN     Data Input:     (stepping rate: 256 kBit/s)
- DOUT    Data Output:     (stepping rate: 256 kBit/s)

The transmission and reception signals of layer 1, which are separated at the IEC, are merged by a termination set and conducted via the symmetrical transmitter to the U interface. The U interface of the module is connected to the U sockets at the front of the K1404 via the measuring panel and the basic wiring (here the power feeding or the load are also connected). With the aid of a decoupling amplifier, a further termination set and a second transmitter, the transmission signal of the IEC is fed separately to the measuring panel and can be observed via an oscilloscope output.

**Clock conditioning** mainly consists of the master clock generation. The master clock of 15.36 MHz is generated by an LC oscillator which is synchronized via a PLL to a reference clock of 1.28 MHz. The reference clock of 1.28 MHz is gained with the aid of a direct digital synthesis (DDS) from an crystal oscillator. There is also the possibility to synchronize the reference clock of 1.28 MHz using another PLL to a system clock of 2.048 MHz or 1.536 Mhz. The U frame trigger signal (1 kHz) is generated in the IOM clock (DLC). The U clock (120 kHz), which is also available as trigger signal, as well as the IOM clock DCL (512 kHz) and the IOM frame clock FSC (8 kHz) are also derived from the master clock.

**B/D channel multiplexer:** The coupling and decoupling of the B channel data, the monitor information and the D channel and command/indicate data are carried out via the IOM interface.

Coupling and decoupling of the data is realised with four shift registers each to adjust the stepping rate of 64 Bit/s or 128 Bit/s to the 256 kBit/s of the IOM. The shift registers are controlled via an EPLD. Data determined for the B channels are generated by an internal PN generator. External data via the B-IN socket at the front can also be interconnected.

In return, the read-out B channel data can be distributed to the internal bit error counter or to the B-OUT socket for an external analysis. The frame and synchronization clock (FSC) and the data clock CLK) are present at the corresponding sockets as a reference.

**Modified S<sub>0</sub> interface:** This interface consists of the ISAC-S (PEP 2086) module and two symmetrical S<sub>0</sub> transmitters. The interface operates locally fed in the TE mode without load, and in the NT mode without feeding. The ISAC-S receives the commands via the module processor.

In addition, the receiver input of the  $S_0$  interface can be switched over for phase jitter measurements via a relay at the corresponding output.

The **module processor** assures the control and communication of the individual components among each other, evaluates the measured results, processes these and sends the result via a FIFO interface to the main processor. This interface is also used to transmit information required for each measuring task to the module processor. Beside the FIFO interface to the main processor, the module processor also provides a V.24 interface for testing purposes.

## 2.2.5 Module $U_p$ for functional tests

The module  $U_p$  carries out the functional tests (C73249-A11-L332). Its main function is providing an ISDN U interface for a full duplex transmission with a time-division multiplex transposed band mode (ping pong). The module forms the counterpart to each device under test operating either as LT or as NT. In addition, the module provides the precondition to read data in and out of the B channels (B1, B2 or (B1+B2)). In this way it is possible to recognize and evaluate errors of the components to be tested when transmitting data. It is also possible to monitor the monitor and the B\* channel by reading out the data content.



Functional tests may be performed with different combinations of modules: either 2B1Q or 4B3T or  $U_p$ , or 2B1Q and 4B3T, or 2B1Q and  $U_p$ , or 4B3T and  $U_p$ .

The plug-in module includes a complete LT (without feeding), switchable to NT (without load), a clock conditioning, a B/D channel multiplexer, a modified  $S_0$  interface and a module processor.

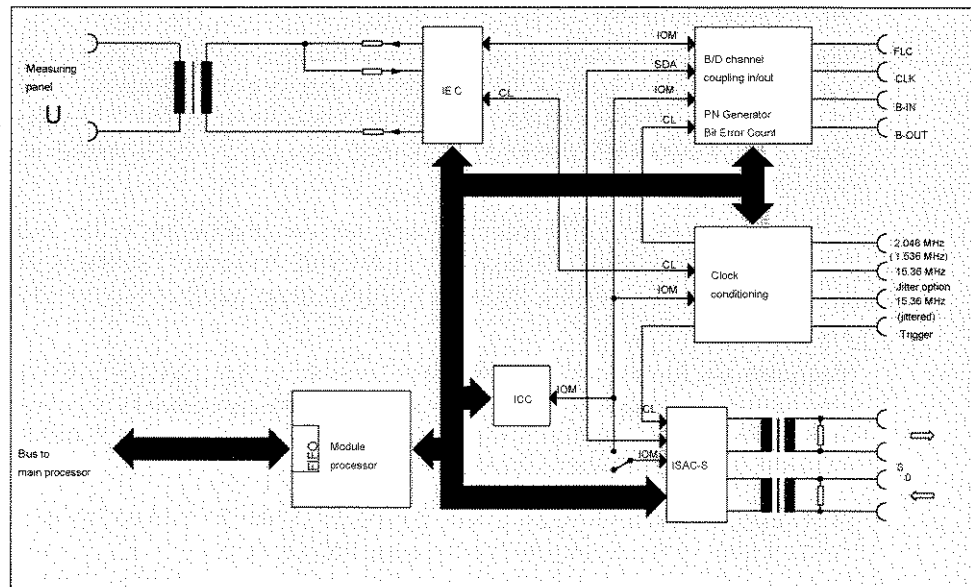


Fig. 2.9: Block diagram of the module Functional Tests

The **LT / NT** consists of an ISDN Communication Controller (ICC), an ISDN Burst Transceiver Circuit (IBC) and a symmetrical U transmitter.

The IBC (PEP 2095) is controlled by the ICC (PEP 2070), the commands (enable, activate, deactivate, test loops etc.) are transmitted to the ICC via the module processor. Communication between the ICC and the IBC takes place via the ISDN oriented modular interface (IOM interface).

The IOM interface is a four-wire interface with the following signals:

- FSC      Framesync      (IOM frame clock 8 kHz)
- DCL      Dataclock:      (512 kHz = double bit clock)
- DIN      Data Input:      (stepping rate: 256 kBit/s)
- DOUT     Data Output:      (stepping rate: 256 kBit/s)

The transmitting channel as well as the receiving channel of the IBC are connected to a symmetrical transmitter, whose secondary side is the U interface. The U interface of the module is connected to the U sockets at the front of the K1404 via the measuring panel and the basic wiring (here the power feeding or the load are also connected).

**Clock conditioning** mainly consists of the master clock generation. The master clock of 15.36 MHz is generated by an LC oscillator which is synchronized via a PLL to a reference clock of 1.28 MHz. The reference clock of 1.28 MHz is gained with the aid of a direct digital synthesis (DDS) from an crystal oscillator. There is also the possibility to synchronize the reference clock of 1.28 MHz using another PLL to a system clock of 2.048 MHz or 1.536 Mhz. The U frame trigger signal (1 kHz) is generated in the IOM clock (DLC). The U clock (120 kHz), which is also available as trigger signal, as well as the IOM clock DCL (512 kHz) and the IOM frame clock FSC (8 kHz) are also derived from the master clock.

**B/D channel multiplexer:** The coupling and decoupling of the B channel data, the monitor information and the D channel and command/indicate data are carried out via the IOM interface.

Coupling and decoupling of the data is realised with four shift registers each to adjust the stepping rate of 64 Bit/s or 128 Bit/s to the 256 kBit/s of the IOM. The shift registers are controlled via an EPLD. Data determined for the B channels are generated by an internal PN generator. External data via the B-IN socket at the front can also be interconnected.

In return, the read-out B channel data can be distributed to the internal bit error counter or to the B-OUT socket for an external analysis. The frame and synchronization clock (FSC) and the data clock (CLK) are present at the corresponding sockets as a reference.

**Modified S<sub>0</sub> interface:** This interface consists of the ISAC-S (PEP 2086) module and two symmetrical S<sub>0</sub> transmitters. The interface operates locally fed in the TE mode without load, and in the NT mode without feeding. The ISAC-S receives the commands via the module processor.

In addition, the receiver input of the S<sub>0</sub> interface can be switched over for phase jitter measurements via a relay at the corresponding output.

The **module processor** assures the control and communication of the individual components among each other, evaluates the measured results, processes these and sends the result via a FIFO interface to the main processor. This interface is also used to transmit information required for each measuring task to the module processor. Beside the FIFO interface to the main processor, the module processor also provides a V.24 interface for testing purposes.

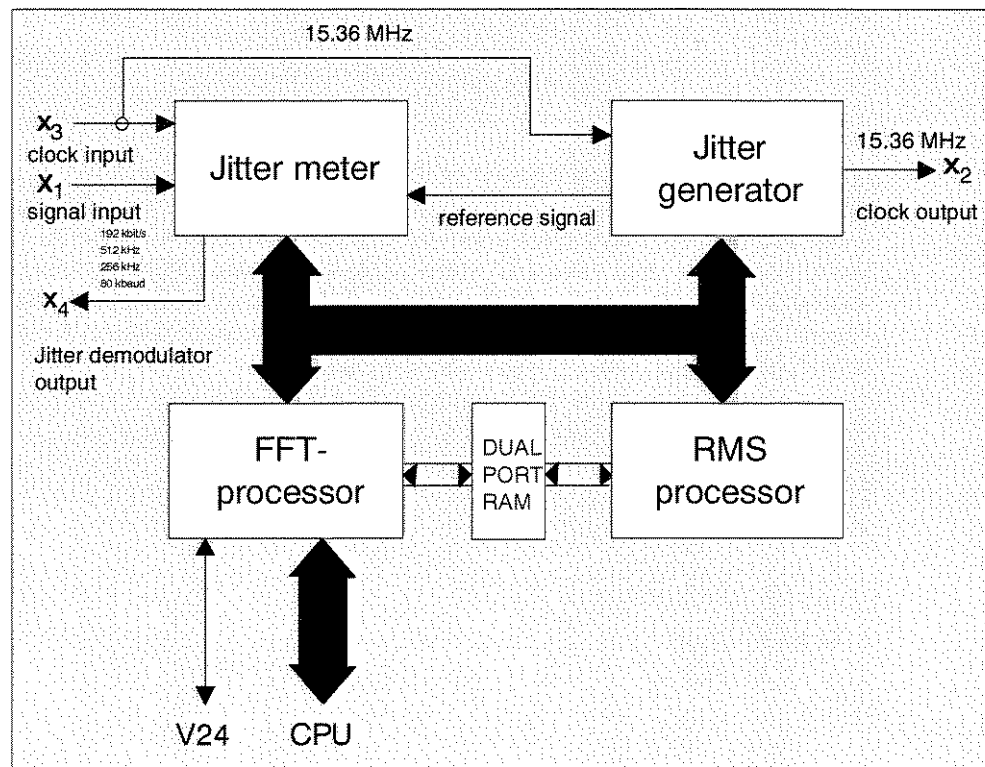
## 2.2.6 Jitter Module

The jitter module allows you to measure the jitter or the jitter sensitivity of an NT. Measurements as defined in the guidelines ETSI ETR 080 and ANSI T1.601 can be performed via this module. These measurements can be carried out at the S0 interface, at the 512 kHz, 256 kHz and 80 kHz clock signals respectively. They can also be carried out directly at the U interface by using a measuring extension (jitterbox).

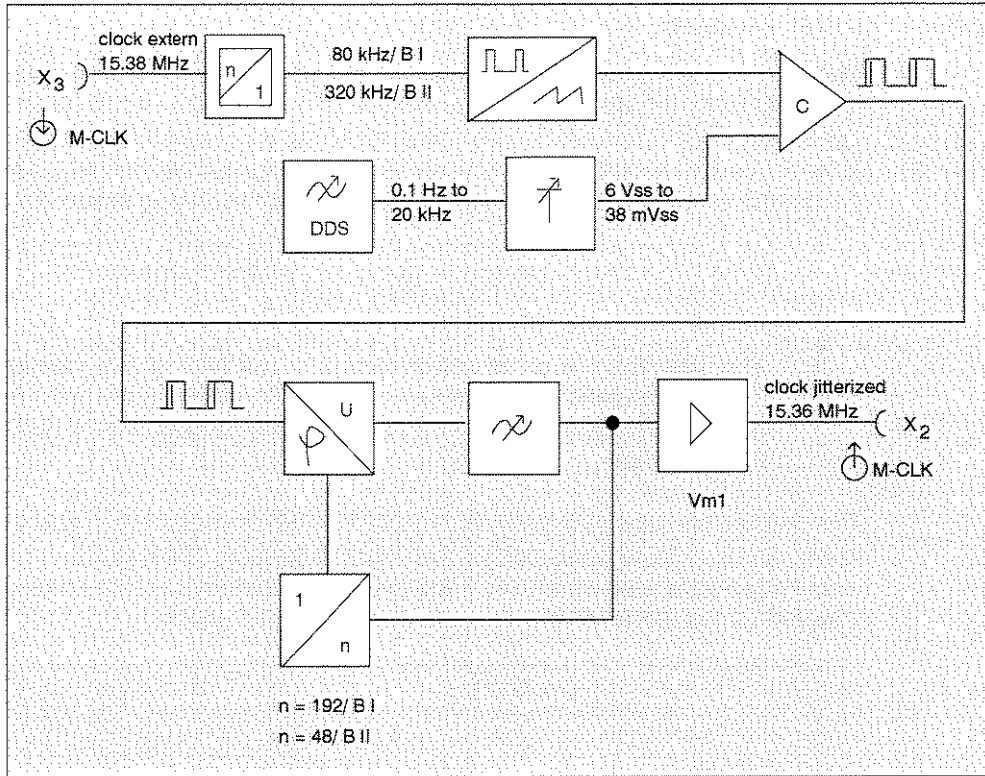


The jitter module is an option which is not part of the standard fitting of K1404. The jitter measurement can only be carried out when the jitter module is implemented. The location for the jitter module is provided by slot 6 on the baseplate.

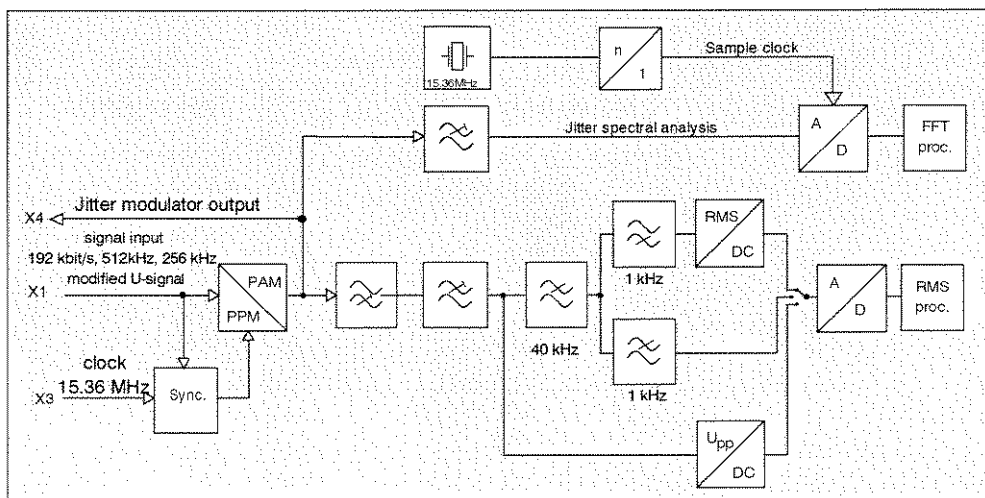
The module contains two function blocks: One function block contains a phase jitter meter which evaluates the jitter on the basis of peak or effective values and displays frequency portions spectrally (FFT analysis). The second function block can jitter the U signal generated by K1404 for both deviation and frequency.



**Jitter generator:** A crystal-controlled 15.36 MHz clock provided by the U interface module is split into a frequency of 80 kHz or 320 kHz and is modulated in a phase modulator with a jitter frequency ranging from 0.1 to 20 kHz. The phase-modulated output signal of the phase modulator is boosted in a PLL to a frequency of 15.36 MHz. In the U interface module the clock for the transmitted signal at the U interface is derived from this phase-modulated clock:



**Jitter meter:** The signal present at the data input is demodulated in a phase demodulator on the basis of a clock signal derived from the U clock. For the purpose of peak and effective value display the demodulated signal is limited in its bandwidth by switchable high- and low-pass filters. Following analog digital transformation, the signal is transmitted to the RMS module. For the power spectral density analysis, the demodulated signal is transmitted to the RMS module without a bandwidth limitation, following an analog digital transformation.



## 2.2.7 Module for power feeding tests

The test unit consists of two modules, the power-generating unit (C73249-A11-L111) and the actual test module (C73249-A11-L110). The test unit measures the feeding characteristics of NT or LT in accordance with guideline FTZ-1TR211 of the Deutsche TELEKOM and the international guideline ANSI T1.601. The measurements take place at the floating, balanced-to-earth NT power supply or the LT source. For this reason, the module processor and all test components are floating.

### Power feeding module L111

The power feeding module L111 consists of the following components

- Low-pass filter and amplifier
- Power amplifier
- Transmitter
- Voltage sources U1 + U2
- Current sink
- Voltage supply for L110

A square-wave signal with a low frequency (17 kHz) is applied to a power amplifier stage following amplification and filtering. The power amplifier is connected as a push-pull stage and delivers the primary current required for the transmitter. Its gain is fixed internally to 20 dB. The various voltages are derived on the secondary side of the transmitter (U0 basic voltage, supply voltages for the floating circuit components). The U0 basic voltage is connected to the actual test module L110 via two controllable voltage sources.

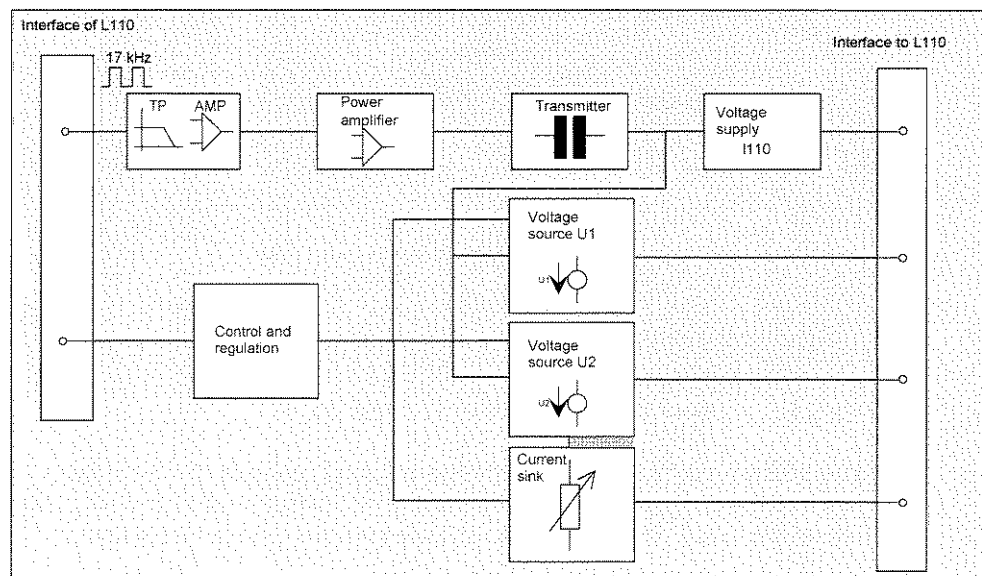


Fig. 2.10: Block diagram of the power feeding module (L111)

### Test module L110

The test module L110 consists of the following components

- Measuring and relay panels
- Input amplifier
- A/D converter
- Controller
- CPU
- FIFO interface

The test unit is used for the following types of measurement:

- Power consumption at the NT
- Start-up test at the NT
- UK0 voltage for all types of measurement

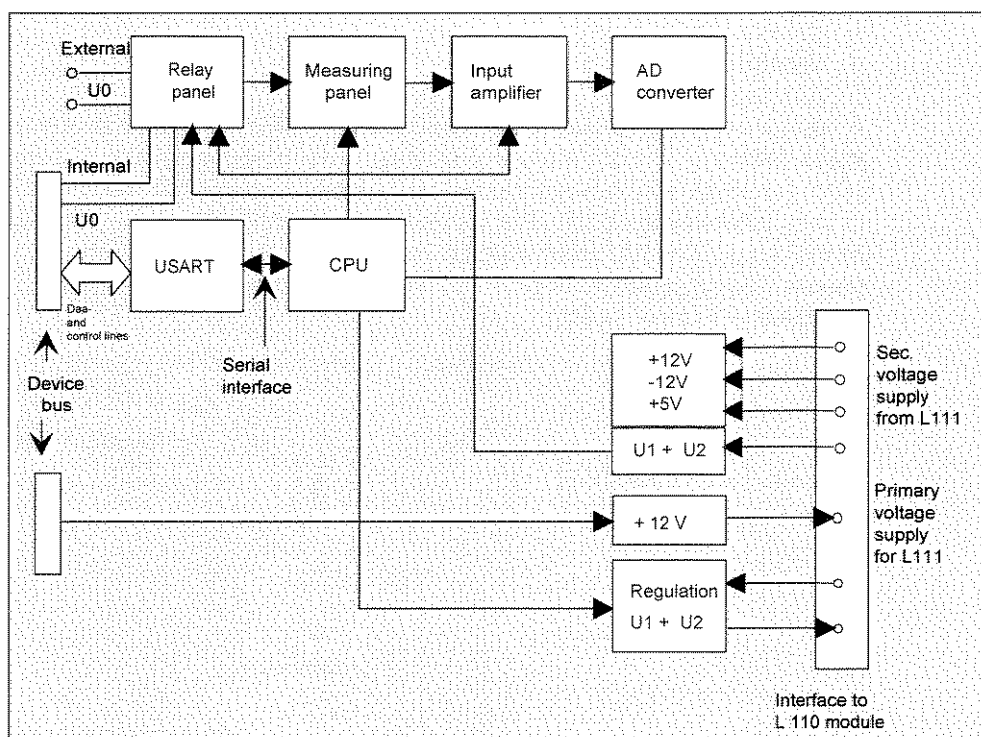


Fig. 2.11: Block diagram Power Feeding module (L110)

The voltage paths of the two voltage sources required for the supply and measurement of the U interface are combined on the **relay panel**. Bistable and monostable relays are used. The relays are activated via the module processor.

On the **measuring panel**, the ranges for current measurement/limitation are set by the connection / parallel connection of various precision resistors. Various series resistors can be connected additionally. The measuring paths are switched through via relays, the coupling to the instrument amplifier is made via FET switches.

The **input amplifier** has a solid gain ( $v=5.48$ ). The measured values are transmitted to an operational amplifier with programmable gain ( $v1= 1, 2, 4, 8, 16$ ) via FET multiplexers. The subsequent 12-bit A/D converter converts the analog voltage to a digital value.



The following calculation for the current measuring range results from the precision resistors of the measuring panel and the programmable gains of the input amplifier:

$$I_{\max} = \frac{U_{\text{ref}}}{R_M * V * V_1}$$

- $I_{\text{MAX}}$  : Maximum current  
 $U_{\text{REF}}$  : Reference for ADC: 3V  
 $R_M$  : Precision resistor  
 $V$  : Gain of input amplifier (V=5.48)  
 $V_1$  : Gain of first operational amplifier AD526

Current measuring range 0..100 mA

$R_M$  : 3.8  $\Omega$

$V_1 = 1$	$I_{\max} = 142 \text{ mA}$
-----------	-----------------------------

Current measuring range 0..50 mA

$R_M$  : 3.8  $\Omega$

$V_1 = 2$	$I_{\max} = 71 \text{ mA}$
-----------	----------------------------

Current measuring range 0..10 mA

$R_M$  : Precision resistor: 10  $\Omega$

$V_1 = 4$	$I_{\max} = 13.6 \text{ mA}$
-----------	------------------------------

Current measuring range 0..2000  $\mu\text{A}$

$R_M$  : Precision resistor: 10  $\Omega$

$V_1 = 16$	$I_{\max} = 3400 \mu\text{A}$
------------	-------------------------------

Current measuring range 0..500  $\mu\text{A}$

$R_M$  : precision resistor: 250  $\Omega$

$V_1 = 4$	$I_{\max} = 540 \mu\text{A}$
-----------	------------------------------

The inputs are protected against overvoltages by protective diodes.

A 12-bit converter with a max. sampling rate of 10 kHz (as a result of CPU cycle times) and an input voltage window of  $\pm 3 \text{ V}$  is used as **A/D converter**. Via this converter, the measured signals, e.g. the current and voltage from devices under test or internal signal variables are digitized and processed further by the CPU.

Two regulated voltage sources and one regulated current sink are present on the power module L111. Part of this **regulation** is present on the module L110. The voltage (current) to be regulated is determined via the instrument amplifier and A/D converter, the controlled magnitude is calculated from this and put into the control loop via control devices.

An Intel **processor** type 80C32 is used. This CPU controls the relay panel, measuring panel, input amplifier and trigger circuit. It evaluates the results, processes them and transmits the result via the serial interface to the main processor. The main processor passes on the information required for the respective measurement to the module processor via the same interface. The serial interface of the CPU can also be used directly for test purposes.

The parallel data bus (D0..7) with the control lines (/RD, /WR, /CS, A1) of the main processor is connected to the USART module. The clock for the **serial interface** is generated by an oscillator/divider. The required transmission rate can be set using jumpers.

- X220 = 9600 Bd
- X221 = 4800 Bd
- X222 = 2400 Bd
- X223 = 1200 Bd

A fixed rate of 1200 Bd is preset at the factory. The other baud rates are exclusively relevant for servicing purposes.

The optocouplers provide electrical isolation between the main processor and the module processor.

An external direct voltage source can be connected at the 4.5 mm **sockets U1(+)** / **U2(-)** for the power feeding of terminals. To do this, external feeding needs to be selected in the menu. The sockets in the measurement "Power Consumption" can also be used for voltage measurement.

Max. input level  $U_{\text{emax}} = 120\text{V VDC}$

(+) = red

(-) = black

There is no overload protection for either the device under test or the source when external feeding is used. Through-connection is effected directly to the device under test by means of a relay.



The symbol on the module label has been printed incorrectly. An output symbol has been used instead of the symbol for the input.

This **socket X6** transmits signals for the control of external components in test setups or enables further external circuit elements for a test setup with K1404.

Pin No.:	Name:	Type:	Assignment:
1	---	Output	Normal/restricted signal for NT
2	free		
3	free		
4	free		
5	free		
6	free		
7	free		
8	free		
9	+12VP	Output	Power supply for external HW; unprotected, max. 25 mA
10	GNDPA	---	Analog ground, primary end
11	free	---	
12	free	---	
13	free	---	
14	free	---	
15	free	---	

## 2.2.8 Main processor unit

The main processor (CPU) is equipped with an 80C186 Intel microcomputer. This 16-bit system has a max. 824 kB program memory and a 128 kB data memory. A built-in crystal oscillator with 11.0592 MHz acts as a clock generator. An NiCd accumulator feeds the data memory and the clock module when the main power supply is switched off.

The module 82786 (22 bit) with the dynamic data memories used as video RAM serves as graphic-coprocessor. Thus, a total monitor memory of 512K to 2MB (normal fitting 512K) is available for the display of menus and results. A slot is already provided for an optional arithmetics coprocessor of the 80C187 type.

Two interrupt controllers (82C59A-2) manage the interrupt signals

```

/INTERRUPT1
/INTERRUPT2      Module interruptions for max. 8
/INTERRUPT3      slave computers
/INTERRUPT4

INT - TXRDY      V.24
INT - RXRDY

INT - TXRDY(TTL) Serial interface TTL
INT - RXRDY(TTL)

TIMER - INT      TIMER module
TASTATUR         Currently not used
IEC - INT        IEC interface
I2C - INT        I2C bus currently not used
GRAF - INT       Graphic controller
INTERRUPT5      Currently not used

```

A V.24 interface is provided for connection of an external printer. The connecting socket BU101 is permanently connected to the PCB. Another V.24 interface is available for internal purposes.

The internal IEC interface can be operated as LISTENER in accordance with the IEEE 488.2 guideline. The connection is provided at the BU102 socket which is also firmly linked to the PCB.

The serial TTL interface is used to control the operating unit (see below).

### EPROM-/RAM memory mapping (80186 address):

Eprom	(512 kByte)
EPROM	(256 kByte)
USER	(64 kByte)
BANK	(64 kByte)
RAM 1	(64 kByte)
RAM 0	(64 kByte)

The UCS is not used; MCS0, MCS1 and MCS3 are applied for communicating with the coprocessor.

BANK memory range: 02 0000H ... 02 FFFFH (image memory for graphic controller)

The following plugs are available at the main processor unit:

- X1 (direction of rear panel)
- X2, middle (direction of front panel)
- X93 for EL display interface
- X96 for 2nd (TTL) serial interface
- X94 for IEC 625 interface (BU 102)
- X95 for the 1st (V24) serial interface (BU 101)

## 2.3 Control unit and power supply

The **control unit** (C73249-A11-L13) is connected to the CPU module via two plug-in band cables.

The control panel is a touch-sensitive display (touch screen). A matrix of infrared beams (16 x 32) is laid over the active display area. If a beam is interrupted during scanning, the controller reports this via the internal V.24 interface to the main processor, thus initiating verification and security routines.

The lines and columns of the IR matrix are cyclically interrogated for interruption. If an interruption is recognized, the line and column coordinate is moved to a FIFO memory of length '3' which is set up in an internal RAM. A new position is reported only if all three memory positions contain the same line or column coordinates. Thus, the output of a new position follows a finger movement. If the IR matrix is exited, a validating message is also output after three interruption-free interrogation cycles.

The keypad is read in once in each interrogation cycle. The pressed key with the highest value is reported as soon as the key has been released (negative active). Together with key T1, double keys can be created.

The six hardkeys of the keyboard are interrogated individually via port pins in order to ensure unambiguous assignments of inputs in the case of multiple activation. The software recognizes the key last pressed as the key with the highest value.

The serial interface operates with

- 1200 baud,
- Full duplex,
- 8 data bits,
- 1 start / 2 stop bits and
- Parity off

A primary-clocked **power supply unit** (W43048-A2001) is used. The line voltage indicated on the rating plate at the rear of the unit is factory-set. It is possible to switch the unit over to a supply voltage of 230 V or 115 V. The power supply unit and the combination filter are directly connected via two lines (blue and black). A yellow green line connects the power supply unit to the central earthing point.

The AC supply is connected via an inlet connector for non-heating appliances at the rear of the unit. Various regulated DC voltages are available at the secondary output.

- Output 1: +5,1V/12 A
- Output 2: +12V/5 A
- Output 3: -12V/2 A
- Output 4: +12V/2 A

The fuses (3.15 A, T-type, 250 V) are located in the housing of the inlet connector for non-heating appliances and can be exchanged without opening the unit.

### 3 Start-up preparations

The following pages will tell you how to make the ISDN-U-Analyzer ready for use. It will also tell you what you must observe when mounting the K1404 modules.



Before switching on, ensure that the operating voltage indicated on the rating plate corresponds to the local power supply!

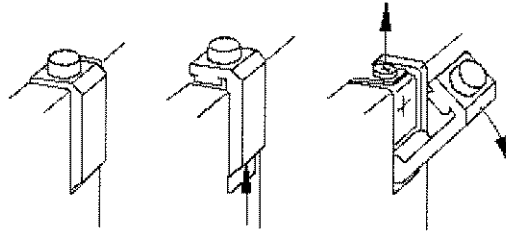
Depending on the country, the device is preset to 115 V or 230 V at the factory. The 115 V setting is labelled by a corresponding sticker on the non-heating appliance socket and by an additional leaflet. The sticker must be removed prior to using the unit!

It is possible to select either 230 V or 115 V. The switch on the rear panel must be set accordingly by means of a screwdriver or coin before using the unit.

### Mounting of a module

First, remove the cover of the device. The fixing screws for the cover are covered by four corner latches. Please proceed as follows:

- Push the corner latches some 4mm upward in direction of the arrow and unhinge the corner latches.



- Loosen the four screws which are now accessible and remove the cover.

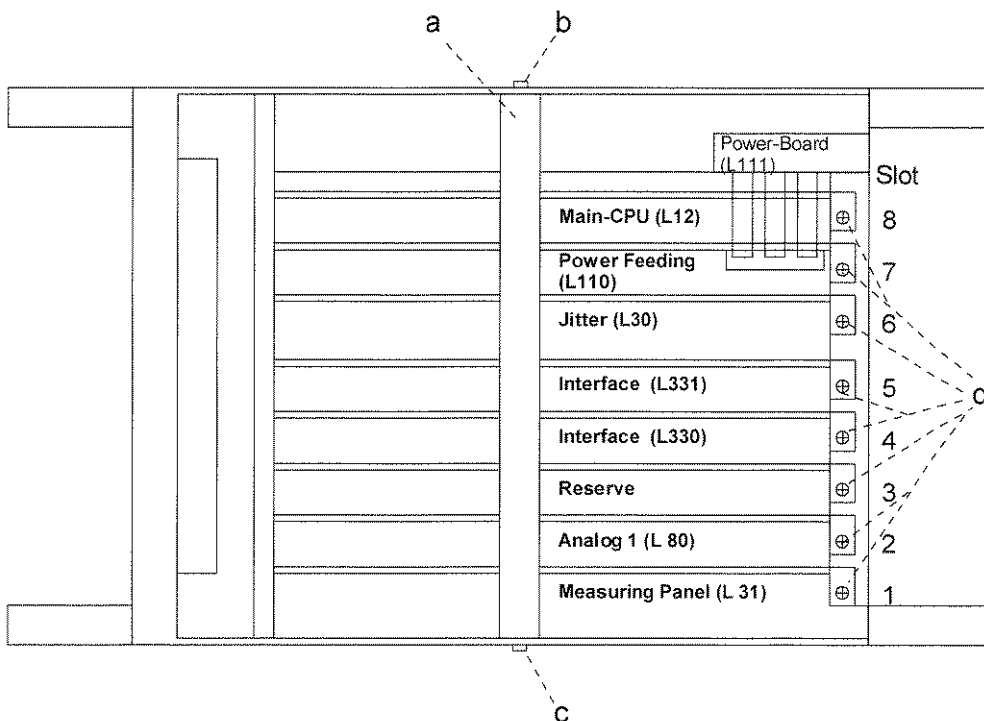


Fig. 3.1: Location of the modules

- Dismount the support (a) by removing screws (b) and (c).
- Loosen the module slot screw (d). Insert the module into its destined slot. Ensure its correct assignment and its proper fit in the guide support.
- Re-fasten the module slot screw (d). Re-mount the support (a): Position the printed board in the grooves of the support and re-fasten screws (b) and (c).
- Re-attach the cover of the device.



### Connecting the power cable

Connect the power cable supplied to the inlet connector for non-heating appliances at the rear of the K1404. The power plug must be fitted into a power outlet with protective earth contact. The ambient temperature must lie between + 5 °C and + 40 °C at the operating site.



The protective effect must not be cancelled by using an extension cable without a protective earth conductor.

### Switching On

Switch on the K1404 by using the MAINS switch on the front of the housing. The unit is booted. Before the first menu appears, a record similar to the following is displayed:

V24A TTLE TTLA IECN FIF1 V240

V1.0 RMX K1403*	(C) by SIEMENS AUT E314 1989	Link: 27.08.92 15:29:09
V1.0 RMX Driver	(C) by SIEMENS AUT E3 1989	Link: 27.08.92 15:28:32
V1.0 K1404 User	(C) by SIEMENS AG ---1993----	Link: 01.03.94 15:16:29

This record indicates which driver (line1) has been installed and which boot programs have been executed (lines 2-4). If an error is detected during installation, the program comes to a halt and places a "?" at the start and end of the message (example: ?V24A?).

A self-test is performed before moving to the basic menu. The test involves the interrogation of the SW version numbers of the module processors. This prevents communication errors, particularly where optional modules are concerned. The module processors normally log in with the following (e.g. with full unit configuration):

```
SELF-TEST .....
ANALOG1 : SW: V1.00   HW: 1.2 C73249-A11-L8
ANALOG2 :
POWER   : SW: V3.0B   HW: L110 07.02.94   15:17:15
MEAS.PANEL:
```

In the event of a fault the program reports a '?' (e.g. ANALOG1 : ?).

If you hit the PADS LOCK key while the self test runs, the module hard- and software version numbers are displayed in the unit menu.



## 4 Operation

The measurements, the test parameters and all equipment parameters are set via menu, by way of selection windows and interactively changing key combinations.

There are only two menu levels: the basic menu (which appears after switch-on) and the working menu. The latter is actively adapted to the given application or operating mode, i.e. only those touch panels which are necessary or expedient for an application are displayed.

Functions or parameters are selected by simply touching the relevant part of the touch screen.



Sections 5 through 8 will tell you how to proceed in each individual mode of measurement. All descriptions follow the same pattern:

First the application routines for **NT** measurements are described.

This is followed by a description of the application routines for **LT** measurements. To avoid redundancies, this so-called Delta description focuses only on those features which are different from the NT variant.



### **Danger!**

Device-internal ground and the housing are connected with the protective earth. Voltages of up to 120 V DC may be present at the measuring sockets U at the front side and between the measuring sockets U and the sockets U1 and U2 at the rear of the device.

Safety sockets serve as protection against unintentional contact with these voltages.

Please observe also: The connection of an external voltage source can lead to the destruction of the device with all modes of measurements!

## 4.1 Operating units and basic menu

The K1404 features only a limited number of other control elements besides the touch screen. These elements comprise the following switches, sockets and hard-keys:

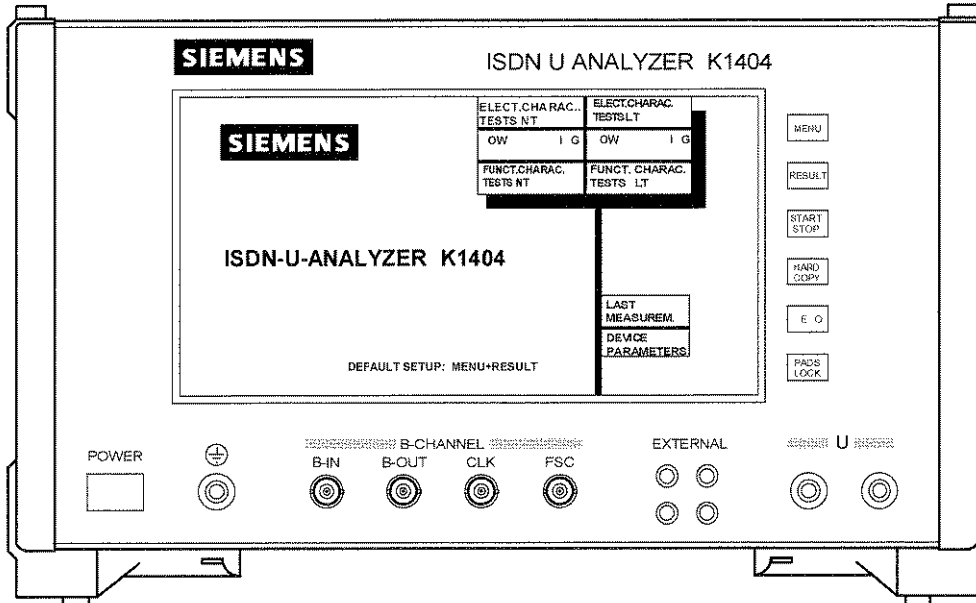


Fig. 4.2: Front view (without jitter)

### Mains switch

#### POWER

Mains switch. The analyzer is switched on or off using this mains switch.

### Sockets at the front panel:



(Protective earth connection)

This socket can be used to connect the protective earth of the K1404 to the reference surface of the test set-up when measuring longitudinal balance.

#### B-IN

Data input for B channels. This socket is assigned to the functional tests module.

$2V_{pp}$ ;  $R_e > 2 \text{ k}\Omega$ ; overvoltage protection against  $V_{CC}$  and GND

#### B-OUT

Data output for B channels. This socket is assigned to the functional tests module.

$2V_{pp}$ ;  $R_a = 50 \Omega$ ; short-circuit proof

## CLK

The reference clock is available at the CLK output. The reference clock can be either 64 kHz or 128 kHz when accessing the B-channels. This socket is assigned to the functional tests module.

$2V_{pp}$ ;  $R_a=50\ \Omega$ ; short-circuit proof

## FSC

The output signal FSC (Frame Signal Clock) is a frame clock signal used for synchronization tasks. This socket is assigned to the functional tests module.

$2V_{pp}$ ;  $R_a=50\ \Omega$ ; short-circuit proof

## U

Using these two safety sockets the device under test can be symmetrically coupled to the K1404 U analyzer.



### **Danger!**

Device-internal ground and the housing are connected to protective ground. Voltages of up to 120 V DC may be present at the measuring sockets U at the front side and between the measuring sockets U and the sockets U1 and U2 at the rear of the device.

## Keys

### MENU

The MENU key is used to return to the basic menu.

### RESULT

The RESULT key can be used to display results for further evaluation after a measurement has been made. Where results are to be displayed in graphic form, for example, a cursor-controlled numerical display is called up.

You can call up the measurement result with RESULT for all graphic displays of results. Invalid results will display  $f=0$  and  $\text{Result}=0$ . This is the case for reflection measurements in the frequency gap and for error measurements as e.g. measurements with an autorange error.

### START/STOP

The START/STOP key is used for starting/stopping a measurement.

### HARDCOPY

The HARDCOPY key is used to print a copy of the screen contents on an external printer.

## MEMO

The MEMO key is used to branch to a menu for selecting measured-value and parameter memories (MEMORY). See also the section "Loading and saving results" further below.

## PADS LOCK

This key locks the touch screen to prevent unintentional actuation, e.g. during continuous measurements. Operation is enabled again when the key is pressed a second time. A status indication (LOCKED) appears in the display. The key is enabled only in the measurement menus.

## MENU + RESULT

The analyzer can be initialized by simultaneously pressing the keys MENU and RESULT. This is necessary following a repair or conversion. Initialization will set the device parameters to their initial settings, all entries stored with MEMO will be deleted.

## Basic menu

The self-test is carried out when the analyzer is switched on. The basic menu is displayed when the self-test has been completed successfully. In the basic menu you can

- select between measurements on the NT or LT,
- re-call the last measurement that was terminated using STOP,
- go to the device parameter menu.

The following modes of measurement may be activated by touching the corresponding panels:

### EL. CHARAC. TESTS NT

Electrical characteristics: Measuring return loss, longitudinal unbalance, longitudinal output voltage, power spectrum density, total power and interference voltage at the NT.

### EL. CHARAC. TESTS LT

Electrical characteristics: Measuring return loss, longitudinal unbalance, longitudinal output voltage, power spectrum density, total power and interference voltage at the LT.

### POWER FEEDING TESTS NT

Power feeding: Measuring power consumption or performing start-up tests at the NT.

### POWER FEEDING TESTS LT

Power feeding: Measuring the power output.

### FUNCT. TESTS NT

Functional tests: Measurements with frequency shift and short-term interruptions and measurements for clock accuracy at the NT.

### FUNCT. TESTS LT

Functional tests: Measurements with frequency shift and short-term interruptions and measurements for clock accuracy at the LT.

#### JITTER MEASUREMENT

The jitter measurement is optional and can only be performed when the corresponding module is implemented. Only in this case the panel is displayed: If you activate this panel, the menu for jitter measurement at the NT will be displayed.

#### LAST MEASUREMENT

After activating this panel, the device parameters which had been selected last are set and the results measured last are displayed on the screen. This, however, is only the case, if the last measurement has been terminated via the STOP key.

#### DEVICE PARAMETERS

This software panel opens an additional menu:

##### LANGUAGE

You may select either GERMAN or ENGLISH as the language of the operator interface.

##### BASIC SETTING

You have a choice depending on the interface modules plugged in. After your choice, turn the device off and on again.

##### PRINTER

Generally, printers of IBM or EPSON graphics format are used. Selecting "Printout to PC" causes the transmission of data in a special format to the PC. For a hardcopy of the display, a printer or a PC must be connected to the V.24 interface of the device.



The circuits of this interface are selected such that the device can operate as a peripheral unit (single-ended) for a controller (PC). In the case of a direct connection of a printer or a PC with a V.24 interface, this means that the pin assignment of the transmission lines may have to be changed (see "Appendix").

##### PRINT FORMAT

If IBM or EPSON is set you can select between print formats NORMAL and 90° ROTATED. When OUTPUT TO PC is set you can choose between SIEMENS HC.EXE and TIFF.

##### IEC BUS ADDRESS


Any IEC bus address from 0 to 30 may be assigned to K1404 via an editing panel.



Please note the current information regarding hardcopy settings in the **readme.txt** file on the enclosed diskette.

### 4.1.1 Sockets at device rear

#### SWITCH BOARD (Slot 1)

 (Ground)

Analog ground of the module SWITCH BOARD

#### SCOPE 1

Measuring output for the connection of external devices, e.g. oscilloscope. A built-in high-resistance symmetrical measuring amplifier directly at the U sockets allows for the observation of the U interface using coaxial measuring devices. (BNC / 50Ω)

#### SCOPE 2

Measuring output for the connection of external devices, e.g. oscilloscope. A built-in high-resistance symmetrical measuring amplifier near the FUNCTIONAL TESTS module allows for the observation of the U interface using coaxial measuring devices. (BNC / 50 Ω)

#### DATA

This signal output is used when measuring phase jitters, i.e. only when the module Jitter Option (L30) is built in. Then, the output must be connected with the corresponding signal input of the L30 module.



The technical data of the individual modules are listed in the Appendix.



**ANALOG 1**

(Slot 2)

**(Level meter)**

At this socket a measuring signal can be supplied to the superimposition receiver of the Analog1 module. Especially suitable is a measuring signal created via the transmission signal available at the BU42 socket. The receiver setting is carried out in the AUTO RANGE mode.

Max. input level  $U_{\text{emax}} = 3.4 \text{ Vpp}$

Input resistance  $R_{\text{e}} = 10 \text{ k}\Omega$

**(Level transmitter)**

Together with input BU41, transmitter output BU42 is intended for connecting external test set-ups. BU42 supplies a sinusoidal signal which can be set via the menu.



Direct voltage must not be applied at this socket.

Output resistance

$R_{\text{a}} \leq 20 \Omega$

**INTERFACE S<sub>0</sub>** (Slot 4 or 5)**S<sub>0</sub>**

Depending on the application, TE or NT functions are available.

**TRIG.**

Trigger output: Either U frame trigger, U clock or event trigger.

**M-CLK (output)**

15.36 MHz master clock

**M-CLK (input)**

15.36 MHz jittered master clock

**SYST.**

2.048 MHz/1.536 MHz system clock input

**POWER FEEDING TESTS** (Slot 7)**U1 (+) / U2 (-)**

The safety sockets U1(+) / U2 (-) can be used to connect an external DC voltage source for feeding NTs. It is necessary to switch to *feeding external* in the menu.

max. input level

$U_{\text{emax}} = 120 \text{ VDC}$

(+) = red

(-) = black



Device-internal ground and the housing are connected with the protective earth. Voltages of up to 120 V DC may be present at the measuring sockets U at the front side and between the measuring sockets U and the sockets U1 and U2 at the rear of the device.

Please observe also: There is no overload protection for either the device under test or the source when external feeding is used. Through-connection is effected directly to the device under test by means of a relay.

**X6**

This socket routes signals for controlling external components in the test set-up or enables further external circuit elements for a test set-up using K1404.

Pin No.	Name	Type	Assignment
1	---	Output	normal/restricted-signal for NT
2	free		
3	free		
4	free		
5	free		
6	free		
7	free		
8	free		
9	+12VP	Output	Power supply for external HW; unprotected, max. 25 mA
10	GNDPA	---	Analog ground, primary end
11	free	---	
12	free	---	
13	free	---	
14	free	---	
15	free	---	

**Main CPU** (Slot 8)

## V.24 BU101

The V.24 interface is set to the following values:

Baud rate: 9600  
 Data bits: 8  
 Stop bits : 1  
 Parity: No parity-check

Pin No.	Name	Type	Assignment
1	SL	---	Protective earth
2	RxD_N	Input	Received data
3	TxD_N	Output	Transmitted data
4	CTS	Input	Printer ready
5	RTS	Output	Computer ready
6	DTR	Output	Computer ready to send
7	GND	---	Ground
20	DSR	Input	Printer ready to send

## IEC 625 BU102

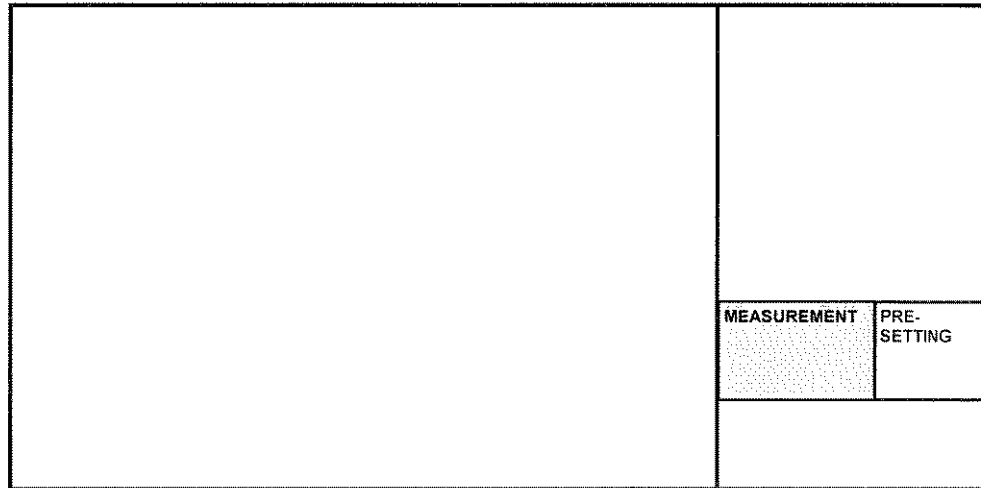
Pin No.	Name	Type	Assignment
1-4 13-16	B1_N - B8_N	Bi-directional	IEC data bus
5	EOI_N	Input	End of identify
6	DAV_N	Bi-directional	Data valid
7	NRFD_N	Bi-directional	Not ready for data
8	NDAC_N	Bi-directional	No data accepted
9	IFC_N	Input	Interface clear
10	SRQ_N	Output	Service request
11	ATN_N	Input	Attention
12	SL	---	Protective earth
17	REN_N	Input	Remote enable
18-24	GND	---	Ground



A detailed description of the IEC interface is given in the section "Remote Control Operation of K1404"

## 4.2 Loading and saving measurement results

After activation of the MEMO key, the menu for loading and saving measurement results and parameters will be displayed.

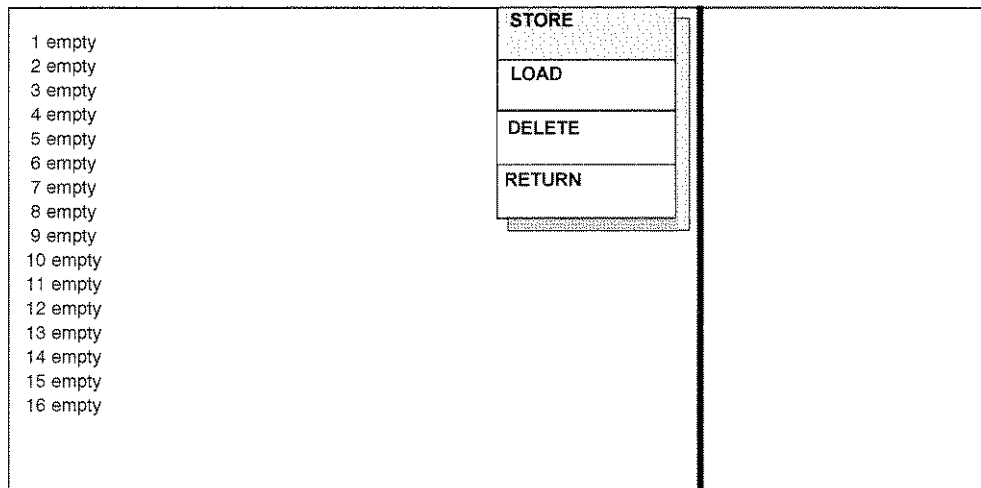


### MEASUREMENT

16 different measurement characteristics or numerical values can be saved (STORE) and recalled into the display when needed (LOAD).

### PRESETTINGS

16 different complete device settings can be saved. For purposes of recurrent applications, each user can pre-select the device settings and save them in one of the memory locations from 1 to 16. If these settings are required, only select and load the relevant memory location.



Use **STORE** to save the measured results.

Use **LOAD** to call up the saved values into the display.

Use **DELETE** to erase memory locations one by one or completely.

Use **RETURN** to go to the measurement menu selected last.



## 5 Measuring electrical characteristics

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS: RETURN LOSS is preset.

If you touch the panel MEASUREMENTS: RETURN LOSS a selection window showing the available modes of measurement will be displayed. You may now select the desired mode of measurement.

		RETURNLOSS	POWER SPEC.- DENSITY	TOL.MASK FF
		LONGITUDINAL BALANCE	TOTAL POWER	REQU. AP N
		LONGITUDINAL OUTPUT VOLT.	NOISE VOLTAGE	
MEASUREMENT (NT)	MODE	TERMINATION	DEVICE	POWER OFF
RETURNLOSS	LOW NOISE	135Ω/150Ω 135 Ω	IS PASSIVE	



The descriptions of the individual measurements are structured as follows:

First the application routines for **NT** measurements are described. This is followed by a description of the application routines for **LT** measurements. To avoid redundancies, this so-called Delta description focuses only on those features which are different from the NT variant.

## 5.1 Return loss

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu, the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS : RETURN LOSS is preset.

First, adjust the feeding voltage to the device under test via the POWER panel.

				OFF	FREQUENCY RANGE 1.0 kHz 200.0 kHz 25Hz/2kHz FILTER 25 Hz	TOL.MASK
				EXTERNAL		OFF
				NORMAL		FREQU. GAP
				NORMAL WITH RL		ON
MEASUREMENT (NT)	MODE	TERMINATION	DEVICE			
RETURNLOSS	LOW NOISE	135Ω/150Ω 135 Ω	IS PASSIVE			

### POWER

This panel opens another menu in which the following settings can be selected:

#### OFF

The feeding voltage is switched off.

#### EXTERNAL

The feeding voltage can be routed via sockets U<sub>1</sub> and U<sub>2</sub> at the rear of the device (feeding, slot 7).

#### NORMAL

The feeding voltage is applied without additional series resistor.

#### \* NORMAL WITH RL

The additional series resistor of 600 Ω simulates a line resistor.



The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

#### EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket once the START key has been activated.

#### TERMINATION

Adjustment of the Analyzer to the device under test: 135  $\Omega$  / 150  $\Omega$ .

Other device settings will depend on your particular measurement tasks:

If measurements are to be performed at the non-activated NT, it is recommended to select the preset FREQUENCY RANGE 1.0 kHz - 200 kHz. In this case the measuring process is interrupted within a small band by 10 kHz (measuring gap) so as to avoid activation of the NT during measurement.

This function may be switched off via the FREQU. GAP panel, e.g. when measuring return loss at an NT which has been deliberately deactivated (via jumper). The measuring gap will not occur when the frequency range has been self-edited.

Measurements can be performed at a device which sends single pulses. The comb-like frequency spectrum of the single pulses allows you to measure return loss between the spectral lines. If the NT is in the SSP state (Send Single Pulse), K1404 can perform this special measurement selectable via the panel DEVICE UNDER TEST / SENDS SINGLE PUSLE.

## FREQUENCY RANGE

Any desired frequency range between 1 kHz and 1 MHz can be edited. The range 1.0 kHz - 200 kHz is already preset.

EDIT
LAST EDIT VALUE
1.0 kHz- 200 kHz
32 V
66 V
115 V

## MODE

LOW NOISE / LOW DISTORTION

In the event of a passive device, i.e. where the device does not superimpose its own signal on the measuring bridge, the MODE LOW NOISE is recommended. If signals from the device are to be expected, select the MODE LOW DISTORTION.

## TOL. MASK

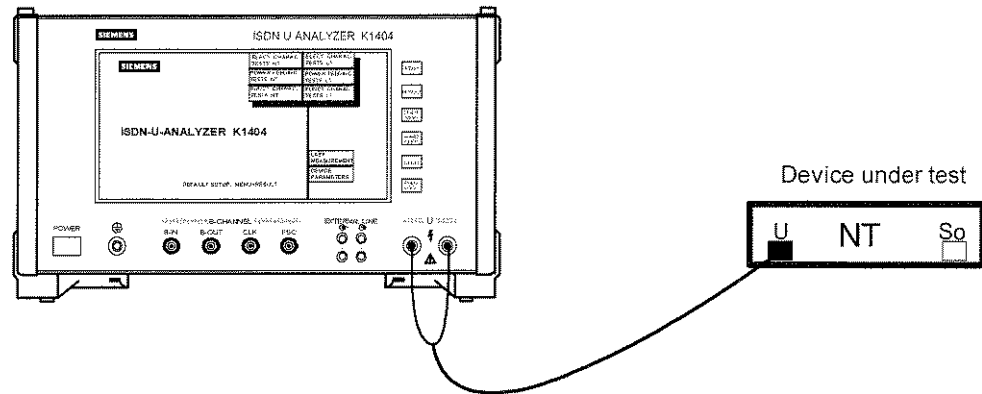
Within the preset frequency range of 1 kHz - 200 kHz the tolerance mask (ANSI) may be displayed in the results display.

## FILTER

25 Hz / 2 kHz

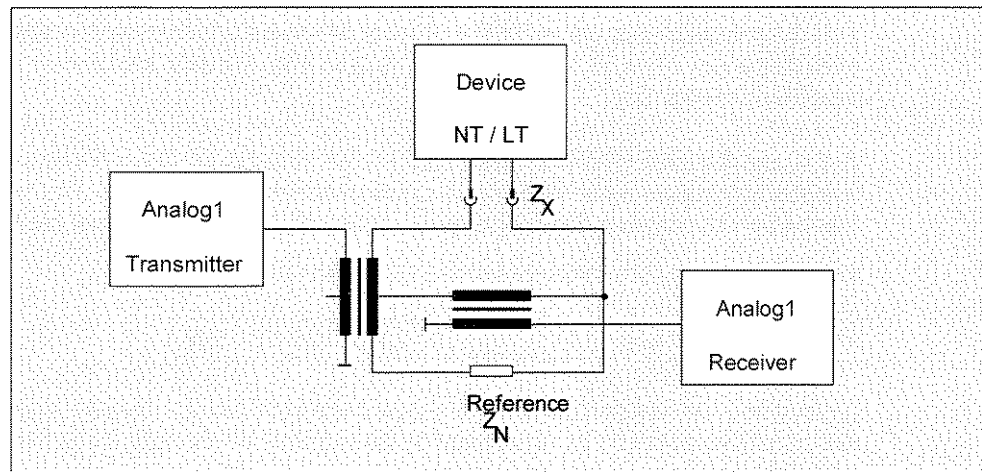
Measuring bandwidth of the Analyzer.

### Test set-up



### Measurement

The measured quantity is the frequency-dependent amount of the return loss at the U interface of an NT. The measurement itself is carried out as follows:



$$\text{Formula: } a_r = 20 \cdot \lg \left| \frac{Z_N - Z_X}{Z_N + Z_X} \right|$$

The measuring bridge (differential transmitter) compares the device under test with a resistance reference. A precision transmitter feeds the differential transmitter, and the bridge voltage proportional to return loss is evaluated. The measurement takes place via the preset frequency bandwidth, and in the gaps of the frequency spectrum in the case of transmitted single pulses.

Start the measurement via the START/STOP key.

First, the measuring panel and the ANALOG1 module are initialized. Then, the following status message "INIT/START" is displayed:

After the start, the transmitter and receiver are automatically calibrated. The actual start of the measurement is indicated by "MEASURE":

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

**Result structure**

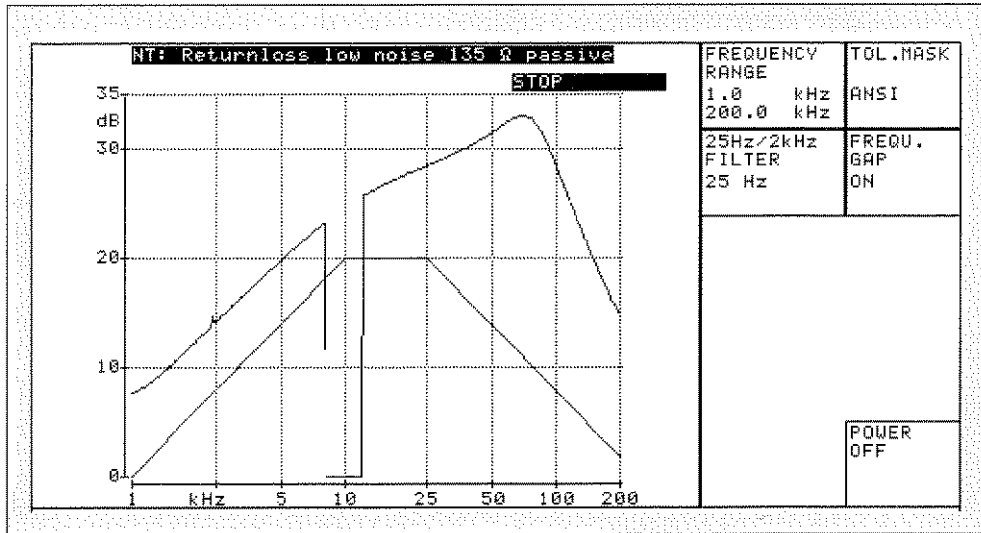


Fig. 5.1: Result structure of return loss

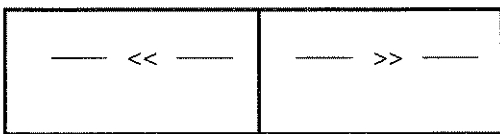
The results display is set up at the start of the measurement and updated cyclically with every run through the frequency range. The current measuring point is indicated by a cursor bar.

In the result mode (RESULT key), a detailed viewing of the measurement characteristics is possible after stopping the measurement (STOP key). The measurement results can be displayed numerically point by point using the cursor (vertical bar).

Measured values are displayed in the following form

Frequ: +30.45 kHz	Loss: +25.62 dB
-------------------	-----------------

By touching the required frequency range the cursor can be moved roughly on the x-axis. It is also possible to move pixel by pixel to the left or right using the cursor keys displayed.



### Measuring at the LT

Measuring return loss at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel POWER which applies to NT measurements is changed to the panel LOAD for LT measurements.

		OFF		FREQUENCY RANGE 1.0 kHz 200.0 kHz	TOL.MASK OFF
		EXTERNAL		25Hz/2kHz FILTER	FREQU. GAP ON
		NORMAL			
MEASUREMENT (LT) RETURNLOSS	MODE LOW NOISE	TERMINATION 135Ω/150Ω 135 Ω	DEVICE IS PASSIVE	LOAD OFF	

### LOAD

With regard to load the following settings may be selected:

#### OFF

The load is switched off.

#### EXTERNAL

Load can be supplied externally via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

#### NORMAL

An operating menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA via an editing panel.

## 5.2 Longitudinal unbalance

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS: RETURN LOSS is preset.

If you now touch the panel MEASUREMENT a selection window will appear which allows you to select the measurement mode LONGITUDINAL UNBALANCE. The following working window is displayed:

				FREQUENCY RANGE	TOL.MASK
				0.5 kHz	OFF
				25Hz/2kHz FILTER	
				25 Hz	
MEASUREMENT (NT)	MODE	TERMINATION	DEVICE		POWER OFF
LONGITUDINAL BALANCE	LOW NOISE	135Ω/150Ω	IS PASSIVE		

First, adjust the feeding voltage to the device under test via the POWER panel. Likewise, adjust the impedance via the TERMINATION panel.

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

## POWER

This panel opens another menu in which the following settings can be selected:

## OFF

The feeding voltage is switched off.

## EXTERNAL

The feeding voltage can be routed via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

## NORMAL

The feeding voltage is applied without additional series resistor.

## NORMAL WITH RL

The additional series resistor of  $600\ \Omega$  simulates a line resistor.

The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket after the START key has been activated.

## TERMINATION

Adjustment of the Analyzer to the device under test:  $135\ \Omega$  /  $150\ \Omega$ .

Other device settings will depend on your particular measurement tasks:

If measurements are performed at the non-activated NT, it is recommended to select the preset FREQUENCY RANGE of 0.5 kHz - 200 kHz. Within this range the tolerance masks (TOL.MASK / ETSI or TOL.MASK / ANSI) are displayed.

MODE

LOW NOISE / LOW DISTORTION

In the event of a passive device, i.e. where the device does not superimpose its own signal on the measuring bridge, the MODE LOW NOISE is recommended. If signals from the device are to be expected, select the MODE LOW DISTORTION.

FREQUENCY RANGE

Any desired frequency range between 1 kHz and 1 MHz can be edited apart from the preset frequency ranges 0.5 kHz - 200 kHz and 1 kHz - 1000 kHz.

EDIT
LAST EDIT VALUE
0.5 kHz- 200 kHz
1.0 kHz- 1000 kHz

TOL.MASK

Within the preset frequency range of 0.5 kHz - 200 kHz the tolerance mask (ANSI / ETSI) may be displayed in the results display.

FILTER

25 Hz / 2 kHz

Measuring bandwidth of the Analyzer.





After the start, the transmitter and receiver are automatically calibrated. The actual start of the measurement is indicated by "MEASURE".

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

**Result structure**

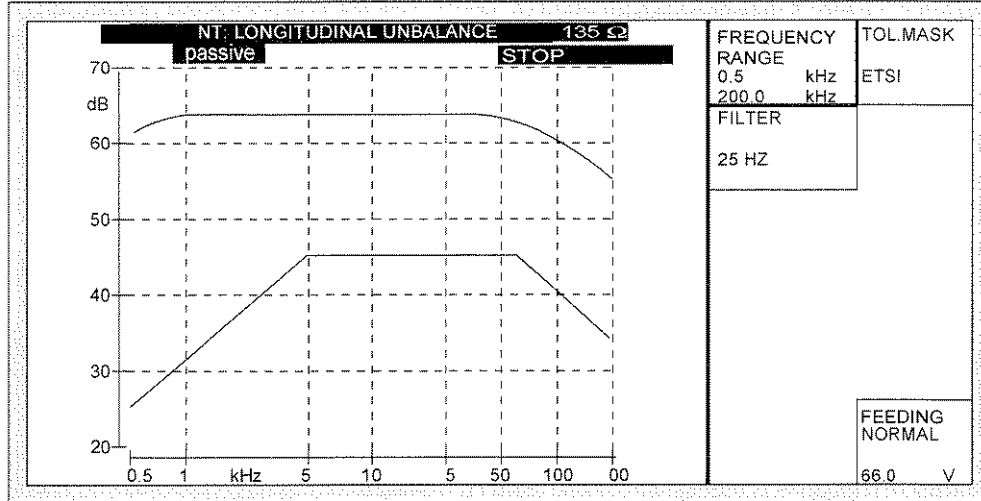


Fig. 5.2: Result structure of longitudinal unbalance

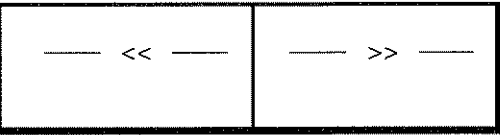
The results display is set up at the start of the measurement and updated cyclically with every run through the frequency range. The current measuring point is indicated by a cursor bar.

In the result mode (RESULT key), a detailed viewing of the measurement characteristics is possible after stopping the measurement (STOP key). The measurement results can be displayed numerically point by point using the cursor (vertical bar).

Measured values are displayed in the following form

Frequ: +73.41 kHz                      Lev: +65.92 dB

By touching the required frequency range the cursor can be moved roughly on the x-axis. It is also possible to move pixel by pixel to the left or right using the cursor keys displayed.



### Measuring at the LT

Measuring longitudinal unbalance at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel POWER which applies to NT measurements is changed to the panel LOAD for LT measurements.

				OFF	FREQUENCY RANGE 0.5 kHz 200.0 kHz	TOL.MASK
				EXTERNAL		OFF
				NORMAL		
					25Hz/2kHz FILTER 25 Hz	
MEASUREMENT (LT) LONGITUDINAL BALANCE	MODE LOW NOISE	TERMINATION 135Ω/150Ω 135 Ω	DEVICE IS PASSIVE			LOAD OFF

#### LOAD

With regard to load the following settings may be selected:

##### OFF

The load is switched off.

##### EXTERNAL

Load can be supplied externally via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

##### NORMAL

An operating menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45mA allows you to set the desired load current between 0 and 100 mA via an editing panel.

### 5.3 Longitudinal output voltage

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS: RETURN LOSS is preset.

If you now touch the panel MEASUREMENT a selection window will appear which allows you select the measurement mode LONGITUDINAL OUTPUT VOLTAGE. The following working window is displayed:

			FREQUENCY RANGE		TOL.MASK
			2.5 kHz	300.0 kHz	OFF
MEASUREMENT (NT)			CONTROL FEEDING	TERMINATION	POWER
LONGITUDINAL OUTPUT VOLT.			OFF	135Ω/150Ω 135 Ω	OFF

First, adjust the feeding voltage to the device under test via the POWER panel. Likewise, adjust the impedance via the TERMINATION panel.

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

## POWER

This panel opens another menu in which the following settings can be selected:

## OFF

The feeding voltage is switched off.

## EXTERNAL

The feeding voltage can be routed via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

## NORMAL

The feeding voltage is applied without additional series resistor.

## NORMAL WITH RL

The additional series resistor of  $600 \Omega$  simulates a line resistor.

The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket after the START key has been activated.

## TERMINATION

Adjustment of the Analyzer to the device under test:  $135 \Omega$  /  $150 \Omega$ .

Other device settings will depend on your particular measurement tasks:

**CONTROL POWER**

Measurement of the longitudinal output voltage is carried out at the activated NT. The device may be activated either by the user (e.g. via jumper in the NT) or by the measuring unit. Activation by the unit itself is only possible in the case of NTs which have been designed for the American standard. Since the device under test does not require feeding via the U interface, it may be deliberately activated by means of direct voltage pulses (NT Maintenance Modes). By touching the panel CONTROL POWER / INSERTION LOSS the activation of the NT via the feeding module L110 of the K1404 is prepared.

**FREQUENCY RANGE**

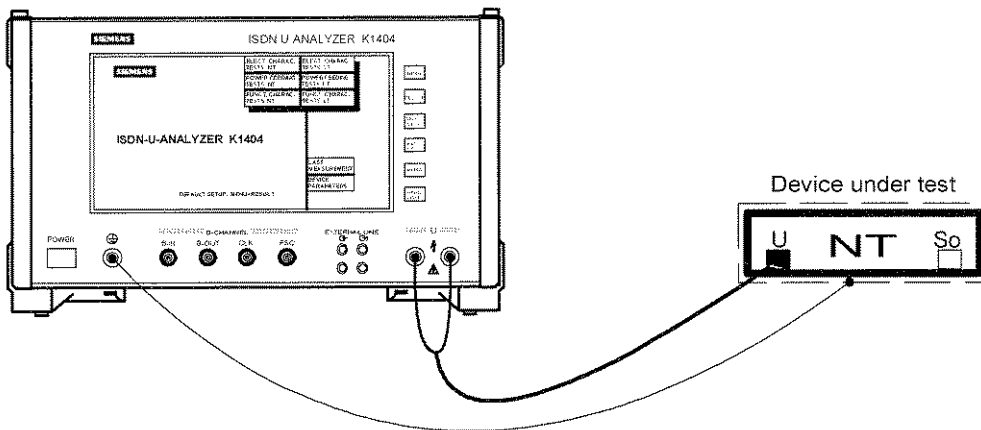
Any desired frequency range can be edited between 2.5 kHz and 1 MHz apart from the frequency ranges of 2.5 kHz - 300 kHz and 2.5 kHz - 1000 kHz.

EDIT
LAST EDIT VALUE
2.5 kHz-300 kHz
2.5 kHz-1000 kHz

**TOL. MASK**

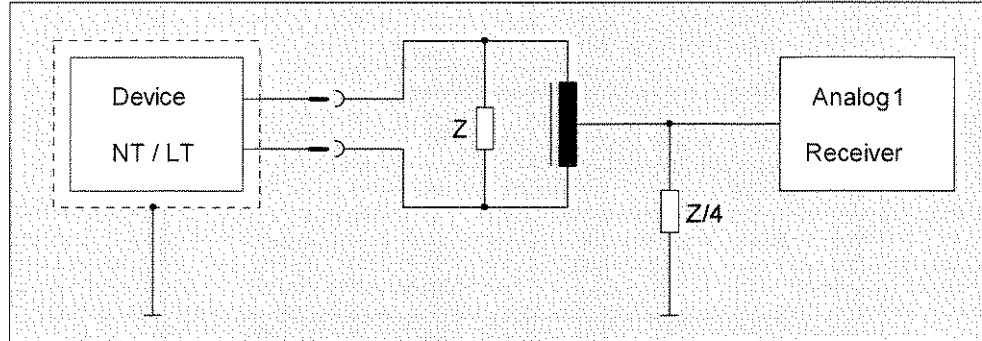
Within the preset frequency range of 2.5 kHz - 300 kHz the tolerance mask (ANSI) may be displayed the results display.

**Test set-up**



### Measurement

The measured quantity is the frequency-dependent amount of the longitudinal output voltage at the U interface of an NT. The device under test must be activated. The measurement itself is carried out as follows:



The device is present at a high-symmetry center-tapped reactor. The measurement receiver of the Analog1 module determines the longitudinal output voltage content of the device at the center tap.

Start the measurement via the START/STOP key.

First, the measuring panel and the ANALOG1 module are initialized. Then, the following status message "INIT/START" is displayed:

After the start, the transmitter and receiver are automatically calibrated. The actual start of the measurement is indicated by "MEASURE":

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

**Result structure**

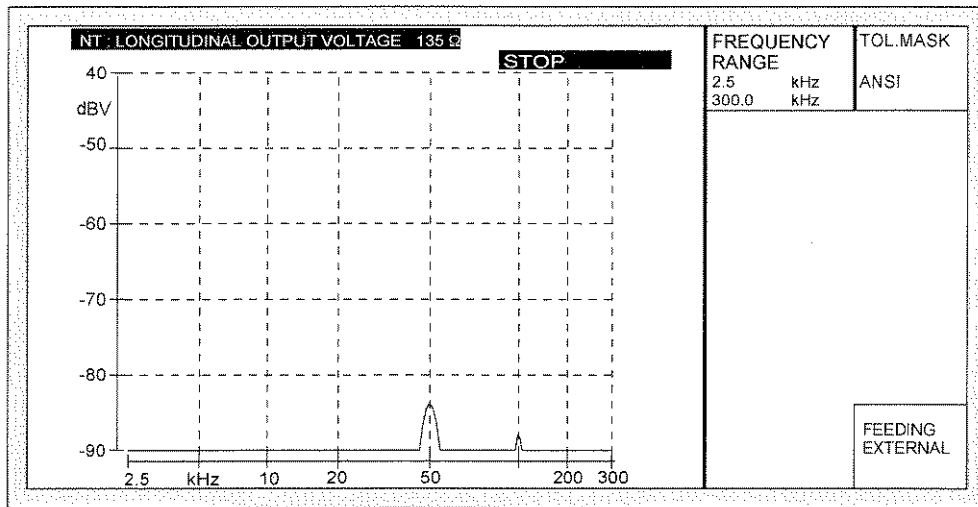


Fig. 5.3: Result structure Longitudinal Output Voltage

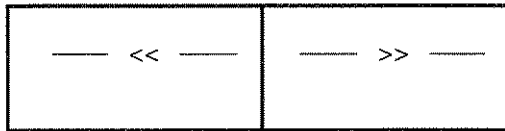
The results display is set up at the start of the measurement and updated cyclically with every run through the frequency range. The current measuring point is indicated by a cursor bar.

In the result mode (RESULT key), a detailed viewing of the measurement characteristics is possible after stopping the measurement (STOP key). The measurement results can be displayed numerically point by point using the cursor (vertical bar).

Measured values are displayed in the following form

Frequ: +50.7 kHz	Lev: -83.92 dB
------------------	----------------

By touching the required frequency range the cursor can be moved roughly on the x-axis. It is also possible to move pixel by pixel to the left or right using the cursor keys displayed.





### Measuring at the LT

When measuring the longitudinal output voltage the LT must be activated (e.g. Loop1).

Measuring at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel **POWER** which applies to NT measurements is changed to the panel **LOAD** for LT measurements.

		OFF	FREQUENCY RANGE		TOL.MASK
		EXTERNAL	2.5 kHz	300.0 kHz	OFF
		NORMAL			
MEASUREMENT (LT) LONGITUDINAL OUTPUT VOLT.		TERMINATION 135Ω/150Ω 135 Ω			LOAD OFF

### LOAD

With regard to load the following settings may be selected:

#### OFF

The load is switched off.

#### EXTERNAL

Load can be supplied externally via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

#### NORMAL

An operating menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA via an editing panel.

## 5.4 Power spectral density

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS: RETURN LOSS is preset.

If you now touch the panel MEASUREMENT a selection window will appear which allows you select the measurement mode POWER SPECTRAL DENSITY. The following working window is displayed:

			FREQUENCY RANGE 2.5 kHz 1000.0 kHz	TOL.MASK OFF
MEASUREMENT (NT) POWER SPEC.- DENSITY	CONTROL ACTIVATION	TERMINATION 135 Ω	POWER OFF	

First, adjust the feeding voltage to the device under test via the POWER panel. Likewise, adjust the impedance via the TERMINATION panel.

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

## POWER

This panel opens another menu in which the following settings can be selected:

## OFF

The feeding voltage is switched off.

## EXTERNAL

The feeding voltage can be routed via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

## NORMAL

The feeding voltage is applied without additional series resistor.

## NORMAL WITH RL

The additional series resistor of  $600 \Omega$  simulates a line resistor.

The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket after the START key has been activated.

## TERMINATION

Adjustment of the Analyzer to the device under test:  $135 \Omega$  /  $150 \Omega$ .

Other device settings will depend on your particular measurement tasks:

**CONTROL**

Measurement of the power density spectrum is carried out at the activated NT. The device may be activated either by the user (e.g. via jumper in the NT) or by the measuring unit. In the case of external activation the interface of the measuring unit remains deactivated when the panel EXTERNAL is selected. By choosing CONTROL ACTIVATION the NT will be activated via the U-interface of the interface module. A third alternative of activating the NT is available if the NT has been designed for the American standard. Since the device under test does not require feeding via the U interface, it may be deliberately activated by means of direct voltage pulses (NT Maintenance Modes). By touching the panel CONTROL / INSERTION LOSS the activation of the NT via the feeding module L110 of the K1404 is prepared.

**FREQUENCY RANGE**

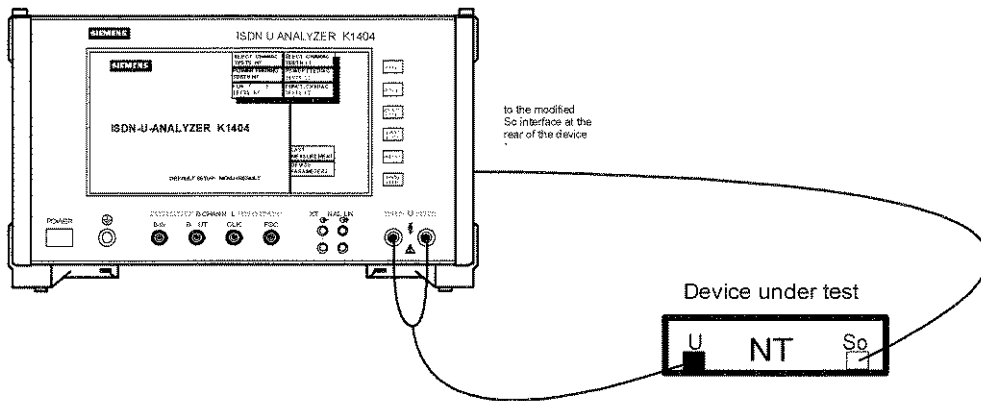
Any desired frequency range between 2.5 kHz - 1000 kHz can be edited apart from the preset frequency range of 2.5 kHz - 1 MHz.

EDIT
LAST EDIT VALUE
2.5 kHz-1000 kHz

**TOL. MASK**

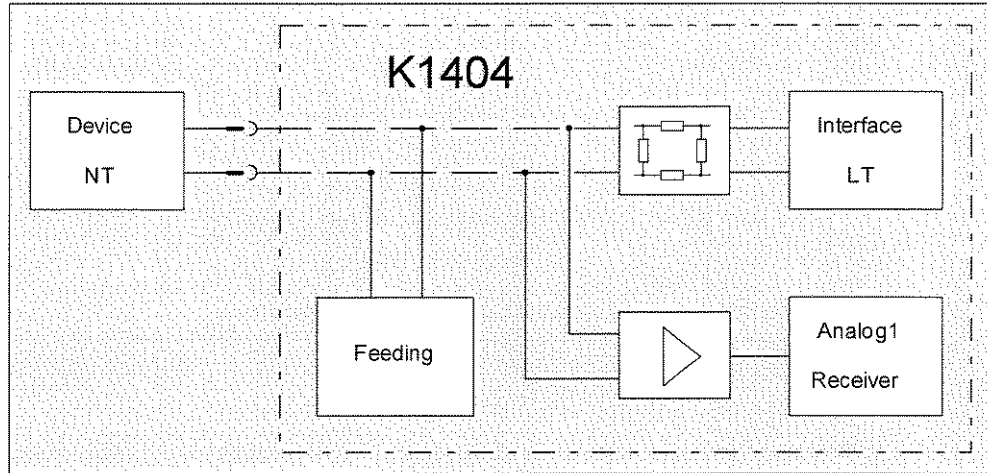
Within the preset frequency range of 2.5 kHz - 1000 kHz the tolerance mask (ANSI) may be displayed in the results display.

**Test set-up**



## Measurement

The measured quantity is the frequency-dependent amount of the power level at the U interface of an NT. The device under test must be activated. Evaluation of the signal at the activated NT is relative to power. The measurement itself is carried out as follows:



A built-in symmetrical probe (measuring head) located directly at the U interface and decoupled by a difference amplifier transmits the measuring signal to the measuring receiver of the Analog1 module for evaluation. The signals from the LT are attenuated via an II-divider.

Start the measurement via the START/STOP key.

First, the measuring panel and the ANALOG1 module are initialized. Then, the following status message "INIT/START" is displayed:

After the start, the transmitter and receiver are automatically calibrated. Following calibration the device under test is activated either by the interface module or by the power feeding module.

The actual start of the measurement is indicated by "MEASURE".

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

**Result structure**

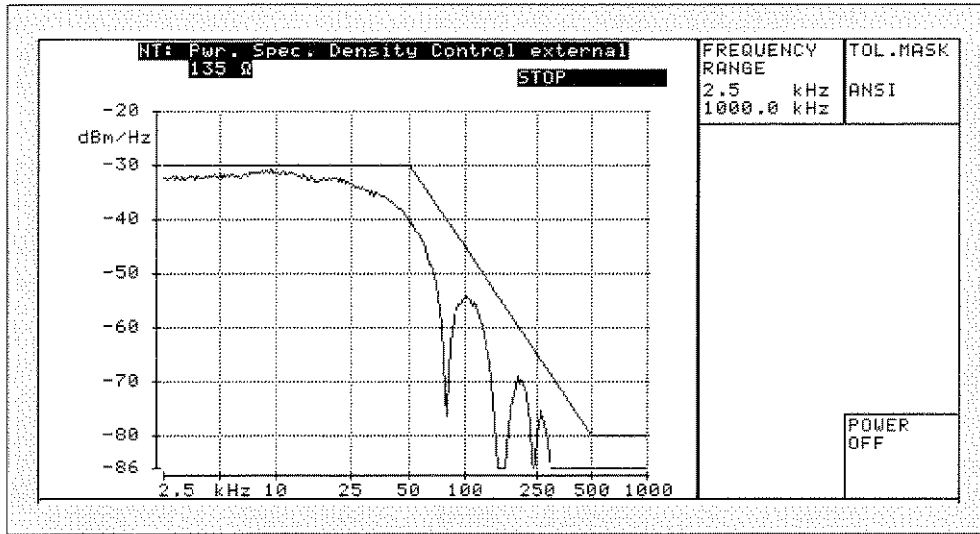


Fig. 5.4: Result structure Power Spectral Density

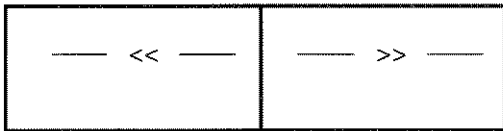
The results display is set up at the start of the measurement and updated cyclically with every run through the frequency range. The current measuring point is indicated by a cursor bar.

In the result mode (RESULT key), a detailed viewing of the measurement characteristics is possible after stopping the measurement (STOP key). The measurement results can be displayed numerically point by point using the cursor (vertical bar).

Measured values are displayed in the following form

Frequ: +73.41 kHz	Lev: -65.92 dB
-------------------	----------------

By touching the required frequency range the cursor can be moved roughly on the x-axis. It is also possible to move pixel by pixel to the left or right using the cursor keys displayed.



**Measuring at the LT**

When measuring the power spectrum density the LT must be activated (e.g. Loop1).

Measuring at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel POWER which applies to NT measurements is changed to the panel LOAD for LT measurements.

			OFF	FREQUENCY RANGE		TOL.MASK
			EXTERNAL	2.5 kHz	1000.0 kHz	OFF
			NORMAL			
MEASUREMENT (LT)	CONTROL	TERMINATION			LOAD OFF	
POWER SPEC.- DENSITY	ACTIVATION	135 Ω				

**LOAD**

With regard to load, the following settings may be selected:

**OFF**

The load is switched off.

**EXTERNAL**

Load can be supplied externally via sockets U<sub>1</sub> and U<sub>2</sub> at the rear of the device (feeding, slot 7).

**NORMAL**

An operating menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA via an editing panel.

## 5.5 Total power

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS: RETURN LOSS is preset.

If you now touch the panel MEASUREMENT a selection window will appear which allows you select the measurement mode TOTAL POWER. The following working window is displayed:

MEASUREMENT <NT> TOTAL POWER	CONTROL ACTIVATION	TERMINATION 135Ω/150Ω 135 Ω	POWER OFF	

First, adjust the feeding voltage to the device under test via the POWER panel. Likewise, adjust the impedance via the TERMINATION panel.

OFF
EXTERNAL
NORMAL
NORMAL WITH RL



## POWER

This panel opens another menu in which the following settings can be selected:

## OFF

The feeding voltage is switched off.

## EXTERNAL

The feeding voltage can be routed via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

## NORMAL

The feeding voltage is applied without additional series resistor.

## NORMAL WITH RL

The additional series resistor of  $600 \Omega$  simulates a line resistor.

The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket after the START key has been activated.

## TERMINATION

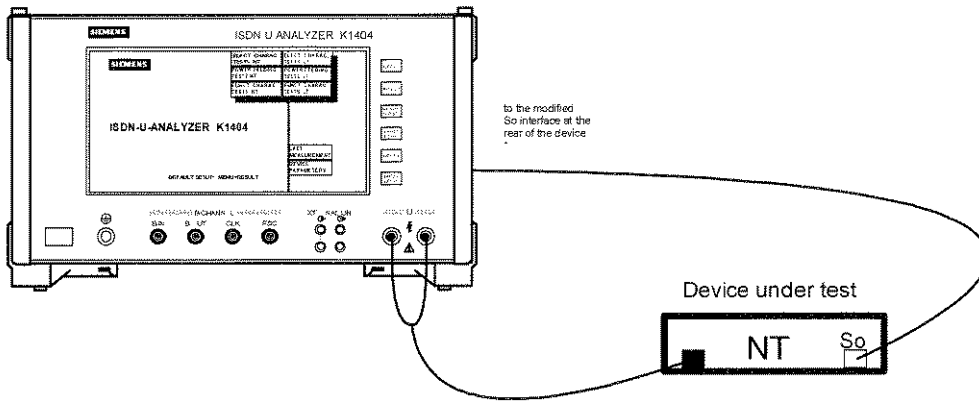
Adjustment of the Analyzer to the device under test:  $135 \Omega$  /  $150 \Omega$ .

Other device settings will depend on your particular measurement tasks:

**CONTROL**

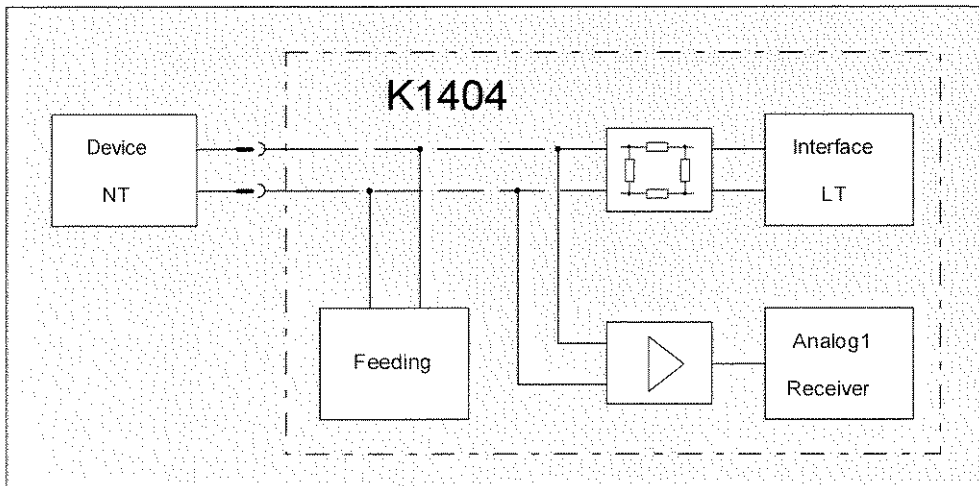
Measurement of the total power is carried out at the activated NT. The device may be activated either by the user (e.g. via jumper in the NT) or by the measuring unit. In the case of external activation the interface of the measuring unit remains deactivated when the panel EXTERNAL is selected. By choosing CONTROL ACTIVATION the NT will be activated via the U interface of the interface module. A third alternative of activating the NT is available if the NT has been designed for the American standard. Since the device under test does not require feeding via the U interface, it may be deliberately activated by means of direct voltage pulses (NT Maintenance Modes). By touching the panel INSERTION LOSS the activation of the NT via the feeding module L110 of the K1404 is prepared.

**Test set-up**



**Measurement**

The measured quantity is the amount of the total signal power over the bandwidth of the 80 kHz at the U interface of an NT. The device under test must be activated. The measurement itself is carried out as follows:



A built-in symmetrical probe (measuring head) located directly at the U interface and decoupled by a difference amplifier transmits the measuring signal to the measuring receiver of the Analog1 module for evaluation. The power of the measuring signal is

determined in steps of 2 kHz (filter bandwidth). The total power is calculated thereof. The signals from the interface (LT) are attenuated via an II-divider.

Start the measurement via the START/STOP key.

First, the measuring panel and the ANALOG1 module are initialized. Then, the following status message "INIT/START" is displayed:

After the start, the transmitter and receiver are automatically calibrated. Following calibration, the device under test is activated either by the interface module or by the power feeding module.

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

### Result structure

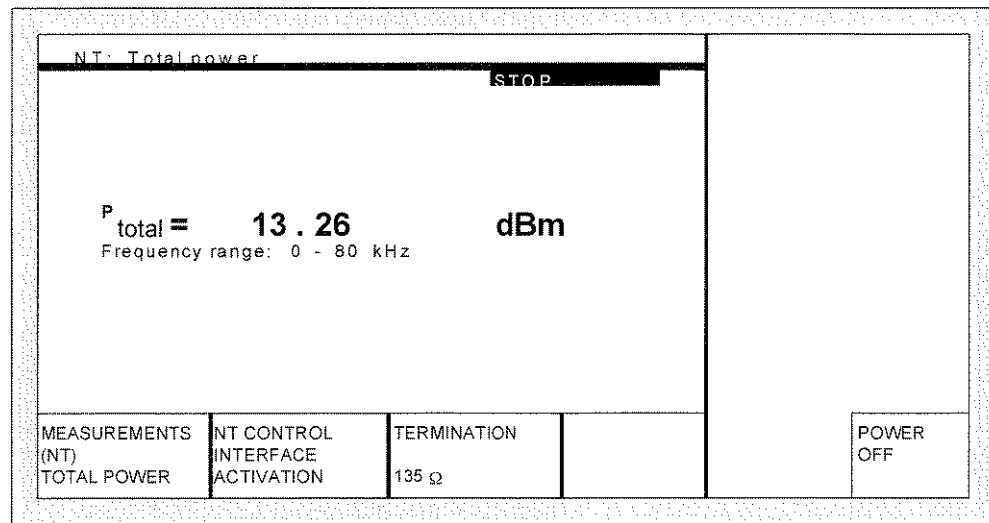


Fig. 5.5: Result structure Total Power

The total power will be displayed ca. 55 seconds after the actual measurement has started.

**Measuring at the LT**

Measuring at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is absolutely necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel POWER which applies to NT measurements is changed to the panel LOAD for LT measurements.

			OFF	
			EXTERNAL	
			NORMAL	
MEASUREMENT <LT> TOTAL POWER	CONTROL ACTIVATION	TERMINATION 135Ω/150Ω 135 Ω		LOAD OFF

**LOAD**

With regard to load the following settings may be selected:

**OFF**

The load is switched off.

**EXTERNAL**

Load can be supplied externally via sockets U<sub>1</sub> and U<sub>2</sub> at the rear of the device (feeding, slot 7).

**NORMAL**

An operating menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA via an editing panel.

## 5.6 Noise voltage

If you touch the panel ELECTRICAL CHARACTERISTICS in the basic menu the working menu appears for the measurement of electrical characteristics. The option MEASUREMENTS: RETURN LOSS is preset.

If you now touch the panel MEASUREMENT a selection window will appear which allows you select the measurement mode NOISE VOLTAGE. The following working window is displayed:

			FREQUENCY RANGE	TOL.MASK
			2.5 kHz	OFF
			540.0 kHz	
MEASUREMENT (NT) NOISE VOLTAGE	CONTROL DEACTIVATION	TERMINATION 135 Ω		POWER OFF

First, adjust the feeding voltage to the device under test via the POWER panel. Likewise, adjust the impedance via the TERMINATION panel.

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

## POWER

This panel opens another menu in which the following settings can be selected:

## OFF

The feeding voltage is switched off.

## EXTERNAL

The feeding voltage can be routed via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

## NORMAL

The feeding voltage is applied without additional series resistor.

## NORMAL WITH RL

The additional series resistor of  $600 \Omega$  simulates a line resistor.

The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket after the START key has been activated.

## TERMINATION

Adjustment of the Analyzer to the device under test:  $135 \Omega$  /  $150 \Omega$  /  $\infty$ .

Other device settings will depend on your particular measurement tasks:

#### CONTROL

Measurement is carried out at the deactivated NT. The device may be deactivated either by the user (e.g. via jumper in the NT) or by the measuring unit. In the case of external deactivation the interface of the measuring unit remains deactivated when the panel EXTERNAL is selected. By choosing CONTROL / DEACTIVATION the NT will be deactivated via the U interface of the interface module. A third alternative of deactivating the NT is available if the NT has been designed for the American standard. Since the device under test does not require feeding via the U interface, it may be deliberately deactivated by means of direct voltage pulses (NT Maintenance Modes). By touching the panel CONTROL / QUIET MODE the deactivation of the NT via the feeding module L110 of the K1404 is prepared.

#### FREQUENCY RANGE

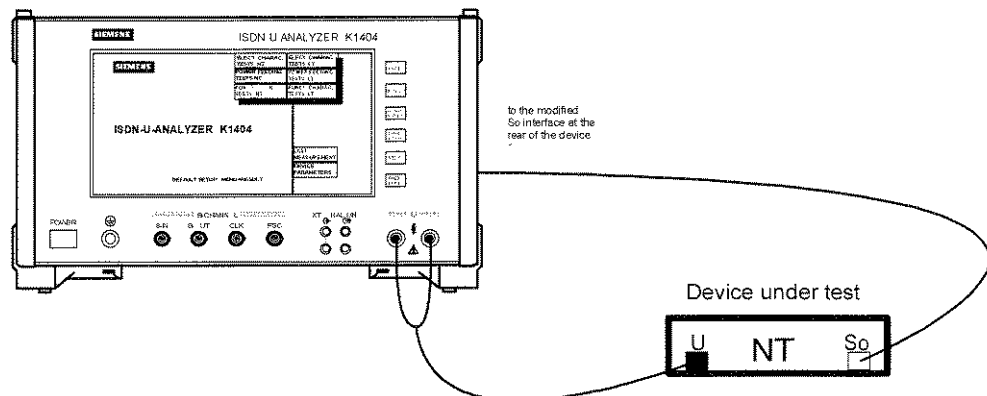
Any desired frequency range between 2.5 kHz and 1 MHz can be edited apart from the frequency ranges of 2.5 kHz - 540 kHz, 500 kHz - 1000 kHz and 0.2 kHz - 2.5 kHz.

EDIT
LAST EDIT VALUE
2.5 kHz- 540 kHz
500 kHz- 1000 kHz
0.2 kHz- 2.5 kHz

#### TOL.MASK

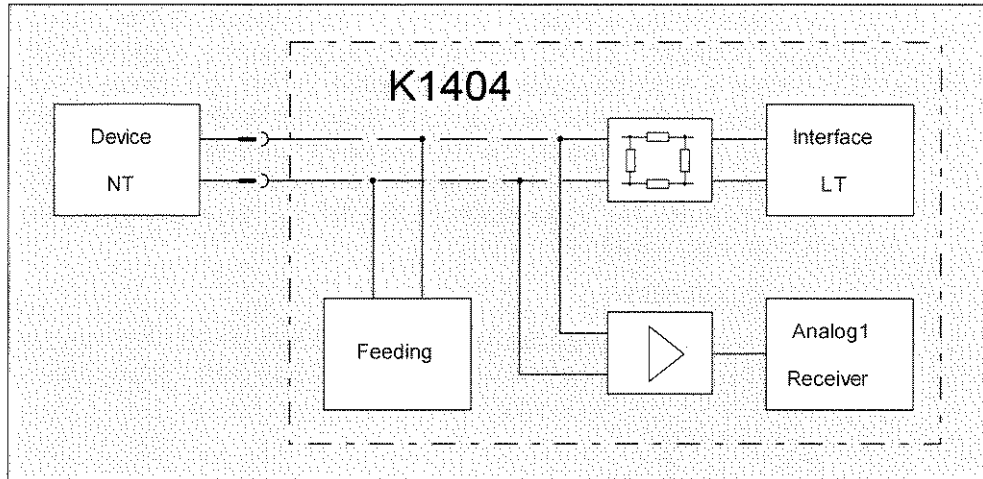
Within the preset frequency ranges the tolerance mask (ANSI) may be displayed in the results display.

#### Test set-up



## Measurement

The measured quantity is the frequency-dependent amount of the interference voltage at the U interface of an NT. The device under test must be deactivated. Evaluation of the signal at the activated NT is relative to power. The measurement itself is carried out as follows:



A built-in symmetrical probe (measuring head) located directly at the U interface and decoupled by a difference amplifier transmits the measuring signal to the measuring receiver of the Analog1 module for evaluation. The signals from the LT are attenuated via an  $\Pi$ -divider.

Start the measurement via the START/STOP key!

First, the measuring panel and the ANALOG1 module are initialized. Then, the following status message "INIT/START" is displayed.

After the start, the transmitter and receiver are automatically calibrated. Following calibration, the device under test is deactivated either by the interface module or by the power feeding module.

The actual start of the measurement is indicated by "MEASURE".

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.



## Result structure

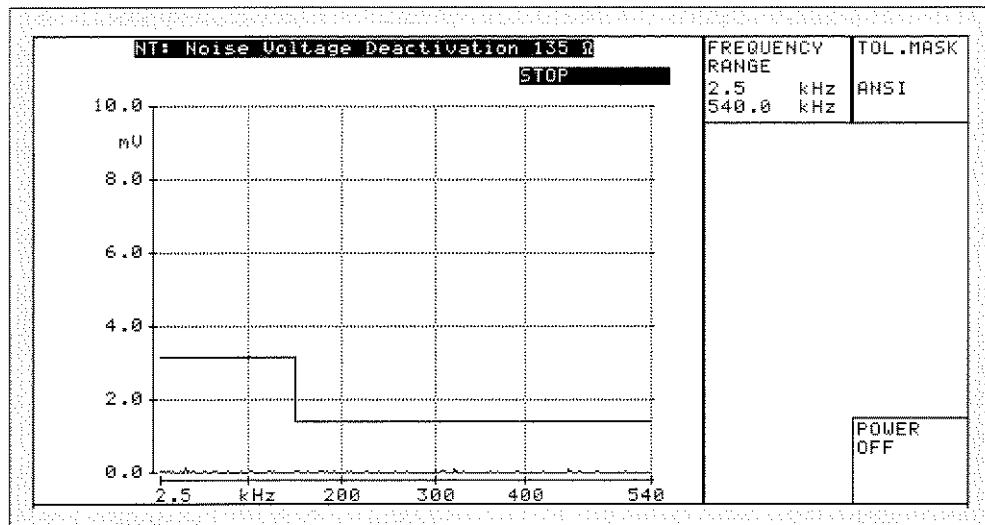


Fig. 5.6: Result structure Noise Voltage

In the result mode (RESULT key), a detailed viewing of the measurement characteristics is possible after stopping the measurement (STOP key). The measurement results can be displayed numerically point by point using the cursor (vertical bar).

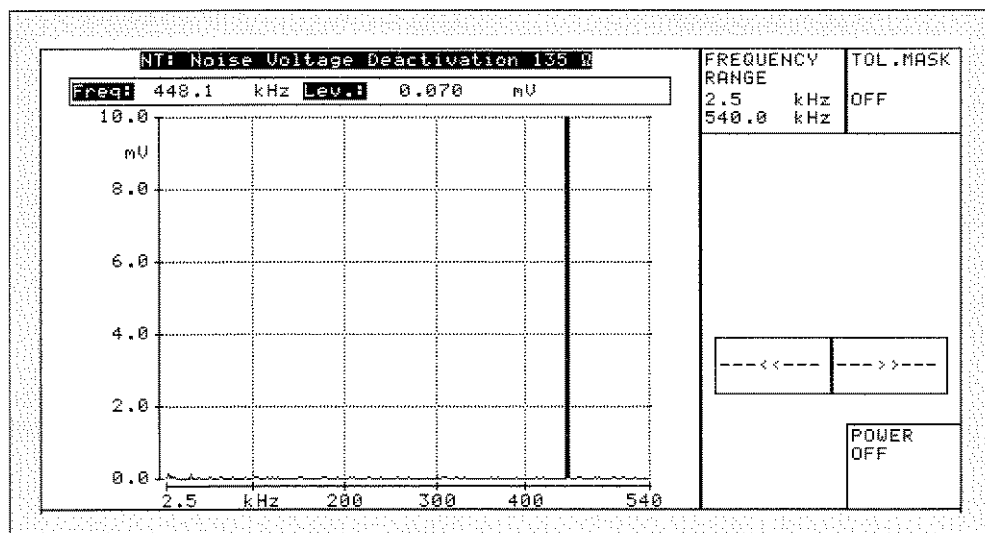


Bild 5.7: Result structure Noise Voltage

In the result mode the cursor bar within the measurement diagram will jump to the position which has been touched on the screen. It can be moved pixel by pixel by touching the cursor keys displayed.

### Measuring at the LT

Measuring at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is absolutely necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel **POWER** which applies to NT measurements is changed to the panel **LOAD** for LT measurements.

			OFF	FREQUENCY RANGE 2.5 kHz 540.0 kHz	TOL.MASK OFF
			EXTERNAL		
NORMAL					
MEASUREMENT (LT) NOISE VOLTAGE	CONTROL DEACTIVATION	TERMINATION 135 Ω			LOAD OFF

#### LOAD

With regard to load the following settings may be selected:

##### OFF

The load is switched off.

##### EXTERNAL

Load can be supplied externally via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

##### NORMAL

An operating menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA via an editing panel.

## 6 Power feeding tests

If you touch the panel POWER FEEDING TESTS NT in the basic menu the working menu appears for the measurement of power feeding characteristics. The option MEASUREMENTS (NT) : POWER MEASUREMENT is preset.

If you touch the panel MEASUREMENTS (NT) : POWER MEASUREMENT a selection window showing the available modes of measurement will be displayed. You may now select the desired mode of measurement.

				POWER CONSUMPTION	LINE RESISTOR 600 Ω
				SWITCH ON TEST	SELECT RANGE 0.. 50 mA
MEASUREMENT (NT) POWER CONSUMPTION	CONTROL DEACTIVATION	CONDITION NT NORMAL	VOLTAGE MEASUREMENT INTERNAL	VOLTAGE 66.0 V	



MEASUREMENTS (LT) : POWER CONDITION is described at the end of this chapter.

The following applies for all measurements of power feeding: an automatic offset adjustment of the current and voltage measuring ranges takes place every 30 minutes. This adjustment does not take place during a running measurement.

## 6.1 Power consumption

If you touch the panel MEASUREMENTS (NT) POWER CONSUMPTION in the basic menu the working menu appears for the measurement of power consumption of an NT. First, adjust the parameters to your test setup and to the device under test.

				LINE RESISTOR 600 Ω	
				SELECT RANGE 0.. 50 mA	
MEASUREMENT (NT) POWER CONSUMPTION	CONTROL DEACTIVATION	CONDITION NT NORMAL	VOLTAGE MEASUREM. INTERNAL	VOLTAGE 66.0 V	

### CONTROL

#### ACTIVATION

Measurements are performed at the activated NT.

#### DEACTIVATION

Measurements are performed at the deactivated NT.

### CONDITION NT

Control of a user-specific application connection by means of which the NT can either be switched separately from the power supply (220/110 V) or connected to it. This allows for remote control activation of both normal and restricted operation.

#### NORMAL

Normal operation

#### RESTRICTED

Restricted operation



Relating to this subject, please note the description of socket X6 in chapter 2.2.6 "Power feeding module".

## VOLTAGE MEASUREMENT

## INTERNAL

The internally measured voltage values are used for the power calculation.

## EXTERNAL

Voltage measurement is performed at the socket pair  $U_1/U_2$  (L110 module, slot 7) which is located at the rear of the device. The socket pair is located at the rear of the device. Therefore it is possible to measure the current applying at the device under test when using an external line or power simulation and to calculate the power taken by the NT.

## VOLTAGE

This panel opens another menu in which you can set the voltage with which the device under test (NT) is to be operated:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 66 V, 96 V and 115 V any desired voltage value between 0 V and 120 V may be set in an editing panel (to be called up via EDIT).

## LINE RESISTOR

This panel opens another menu, in which you can set the line resistor:

OFF
600 $\Omega$
1000 $\Omega$
1400 $\Omega$

The copper resistance of a transmission loop is simulated by switchable fixed-value resistors: 600  $\Omega$ , 1000  $\Omega$  and 1400  $\Omega$  can be directly selected. Select the line resistor OFF when connecting external or artificial lines in series.

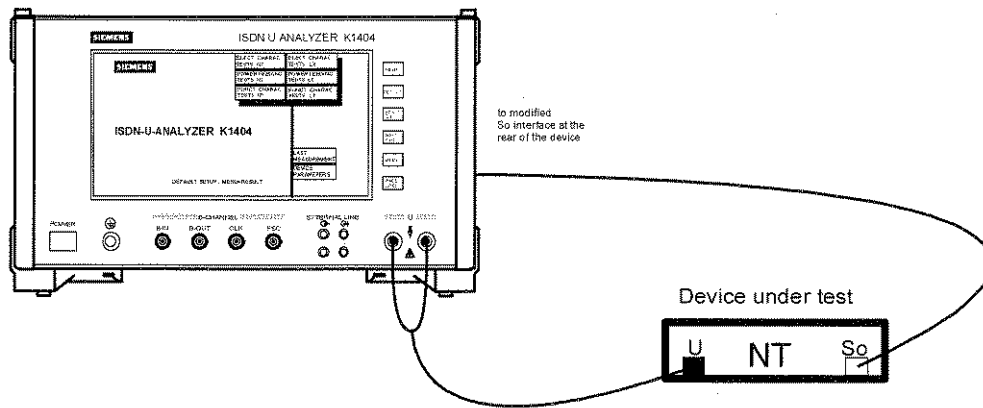
**SELECT RANGE**

This panel opens another menu in which you may select the measuring range:

0.. 500 $\mu$ A
0.. 2000 $\mu$ A
0.. 10 mA
0.. 50 mA

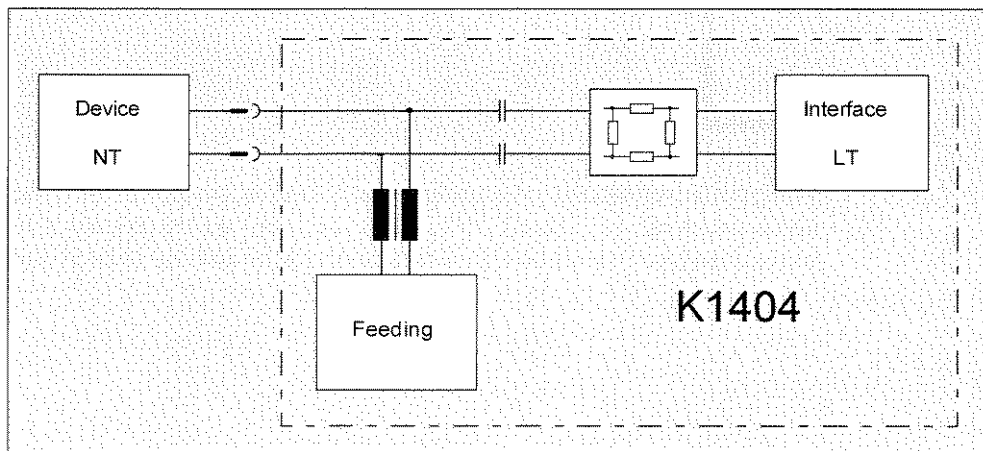
The K1404 measuring ranges can be optimally adjusted to the power consumption of the device under test. This makes it possible to improve the measuring accuracy. Basic setting: 50 mA.

**Test set-up**



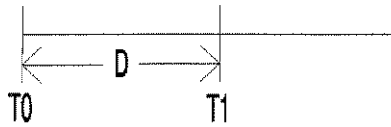
**Measurement**

The measured quantities are the supply current and voltage of the NT. The device under test is either active or not active. The measurement itself is carried out as follows:



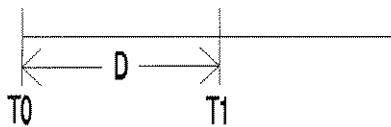
An adjustable DC voltage supplies the device under test. Following output of the DC voltage the least sensitive measuring range is first set:

- Measurement without activation



T0: Time of voltage output  
 T1: Start of measurement  
 D : Time of delay approx. 2 s

- Measurement with activation



T0: Time of voltage output  
 T1: Start of measurement  
 D : Activation of NT

After this time, the selected current measuring range is switched on and the measurement is started. Current and voltage are measured every 2 ms and the resulting values used for a "quasi" realtime power calculation. To establish the MIN/MAX power and current values the measured values taken over a period of 50 ms are averaged. The power and current consumption of the device under test is averaged over a time period of 500 ms and displayed. The MIN/MAX value given for the current is the value measured at the respective MIN/MAX power value.

NT: Power Consumption				MEASURING	LINE RESISTOR 600 Ω
Pact[W]	Pmin[W]	Pmax[W]	SELECT RANGE 0.. 10 mA		
421.E-3	420.E-3	473.E-3			
I(Pact) [A]	I(Pmin) [A]	I(Pmax) [A]			
6.80E-3	6.79E-3	7.71E-3			
U(Pact) [V]					
61.9					
			MIN. MAX. NEW VALUE		
MEASUREMENT (NT) POWER CONSUMPTION	CONTROL DEACTIVATION	CONDITION NT NORMAL	VOLTAGE MEASUREMENT. INTERNAL	VOLTAGE 66.0 V	

After activation of the panel MIN/MAX VALUES NEW the minimum/maximum current and power values are newly determined.

Within the measuring range 0..500  $\mu$ A the measuring resistor 250  $\Omega$  is switched on the module L110. The actual line resistance is then 240  $\Omega$  larger than the value given in the `Line resistor` menu. As a result, the voltage drop over the line resistance in this current measuring range is  $\leq 120$  mV (240  $\Omega$  x 500  $\mu$ A).

When the menu points `Line resistor OFF` and the `Measuring range 0..500 $\mu$ A` are selected, a line resistor of 319  $\Omega$  results due to the measuring resistor (250  $\Omega$ ) and the resistance of the power feeding reactor (69  $\Omega$ ). In the case of any other measuring range with the same setting `Line resistor OFF` a line resistor of approx. 76  $\Omega$  results which consists of the measuring resistance (10  $\Omega$ ) and the resistance of the power feeding reactor (66  $\Omega$ ). The menu point `Line resistor OFF` may be used for an external line or an artificial line.

In order to protect the hardware of the Analyzer K1404 and of the device under test, the following values are set for current limitation relative to the current measuring range:

Current measuring range:	Preset current limitation:
0..50 mA	ca. 55 mA
0..10 mA	ca. 46 mA
0..2 mA	ca. 46 mA
0..500 $\mu$ A	ca. 1.6 mA to 4 mA

Start the measurement via the `START/STOP` key. First, the measuring panel and the module L110 are initialized. Then, the following status message "INIT/START" is displayed:

The actual start of the measurement is indicated by "MEASURE".

Abort the measurement via the `START/STOP` key. The status message "STOP" will appear in the display.



## Result structure

NT: Power Consumption				LINE RESISTOR
STOP				600 Ω
Pact[W]	Pmin[W]	Pmax[W]	SELECT RANGE	
310.E-3	310.E-3	311.E-3	0.. 10 mA	
I(Pact) [A]	I(Pmin) [A]	I(Pmax) [A]		
4.92E-3	4.92E-3	4.93E-3		
U(Pact) [V]				
63.0				
MEASUREMENT (NT)	CONTROL	CONDITION NT	VOLTAGE MEASUREM. INTERNAL	VOLTAGE 66.0 V
POWER CONSUMPTION	DEACTIVATION	NORMAL		

Fig. 6.8: Result structure Power Consumption

The results display is set up at the start of the measurement and is continuously updated.

## 6.2 Switch-on test

If you touch the panel MEASUREMENTS (NT): SWITCH-ON TEST the working menu appears for the measurement of the power consumption of an NT. First, adjust the parameters to your test setup and to the device under test.

				LINE RESISTOR 600 $\Omega$	
				SELECT RANGE 0.. 100 mA	
				MEASURE- TIME 1s	
MEASUREMENT (NT) SWITCH ON TEST	CONTROL DEACTIVATION	CONDITION NORMAL	OFF STATE TEST OFF	VOLTAGE 66.0 V	

### CONTROL

#### ACTIVATION

Measurements are performed at the activated NT. In this mode of measurement, the power feeding reactor is short-circuited. This means that in case of a low line resistor the activation of the NT is not possible! If an activation is desirable, LINE RESISTOR / 1000  $\Omega$  or LINE RESISTOR / 1400  $\Omega$  must be set.

#### DEACTIVATION

The NT is measured in the deactivated state.

### CONDITION NT

Control of a user-specific application connection by means of which the NT can either be disconnected from the power supply (220/110 V) or connected to it. This allows for remote control activation of both normal and restricted operation.

#### NORMAL

Normal operation

#### RESTRICTED

Restricted operation



Relating to this subject, please note the description of socket X6 in chapter 2.2.6 "Power feeding module".

## VOLTAGE

This panel opens another menu in which you can set the voltage with which the device under test (NT) is to be operated:

EDIT
LAST EDIT VALUE
32 V
66 V
115 V

## EDIT

Apart from the preset voltages 66 V, 96 V and 115 V any desired voltage value between 0 V and 120 V may be set in an editing panel (to be called up via **EDIT**).

## LINE RESISTOR

This panel opens another menu, in which you can set the line resistor.

OFF
600 $\Omega$
1000 $\Omega$
1400 $\Omega$

The copper resistance of a transmission loop is simulated by switchable fixed-value resistors: 600  $\Omega$ , 1000  $\Omega$  and 1400  $\Omega$  can be directly selected. Select the line resistor **OFF** when connecting external or artificial lines in series.

## SELECT RANGE

This panel opens another menu in which you may select the measuring range:

0.. 500 $\mu$ A
0.. 2000 $\mu$ A
0.. 10 mA
0.. 50 mA
0.. 100 mA

The K1404 measuring ranges can be optimally adjusted to the power consumption of the device under test. This makes it possible to improve the measuring accuracy. Basic setting: 100 mA.

## DURATION OF MEASUREMENT

The duration of the measurement is variable: within the range of 500 ms and 64 s the following values may be directly selected:

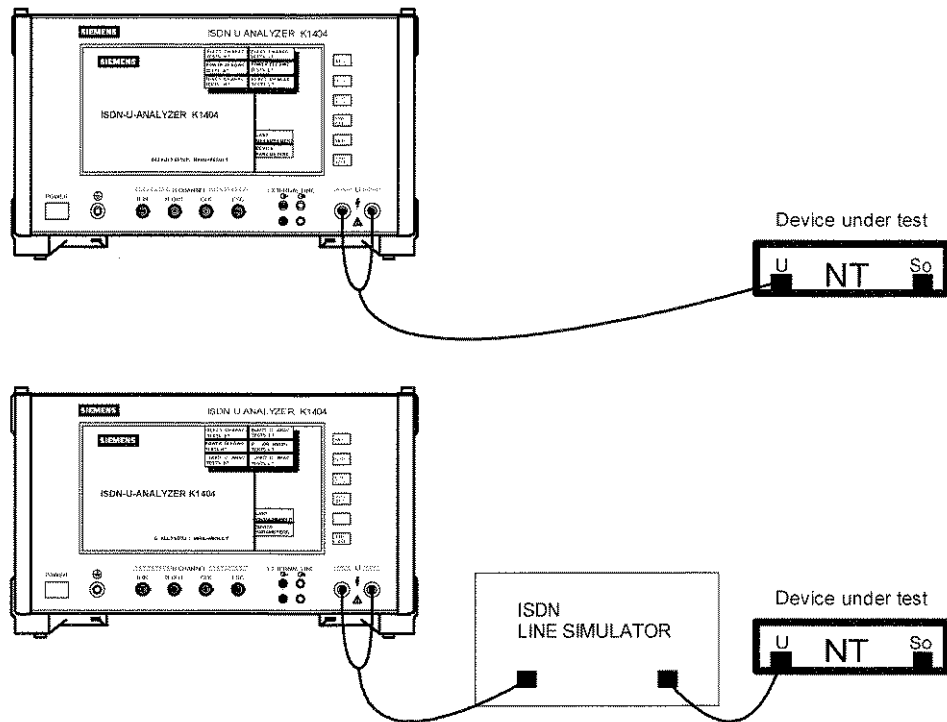
500 ms	8 s
1 s	16 s
2 s	32 s
4 s	64 s

## OFF STATE TEST

## OFF/ON

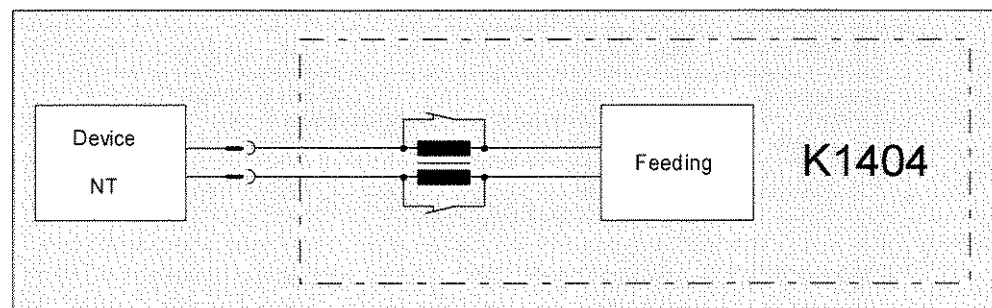
Use this menu point for setting the measurement process (see section "Measurement" below).

## Test set-up



## Measurement

The measured quantity is the making current of the NT relative to time. The measurement itself is carried out as follows:



If the menu point CONTROL : ACTIVATION is selected, a trial activation of the NT is carried out after the start of the measurement before the feeding voltage is switched on. The subsequent measuring process is defined via the setting OFF STATE TEST.

OFF STATE TEST: OFF

The current measurement starts after the feeding voltage is switched on. Depending on the duration of the measurement, a certain number of current values is scanned. These values are averaged in the evaluation. The following table shows the relations of measurement duration, number of measured values, scanning time and the number of current values averaged per time unit. The voltage is still output after termination of the current measurement.

## OFF STATE TEST: ON

At the beginning, for the duration of 4 seconds, the feeding voltage is output. After this, the voltage 18 V is set. Measurement of the current starts ca. 20 ms after the feeding voltage of 18 V has been reached. The measurement process is then the same as for OFF STATE TEST: OFF.

Measured time	Number of current values stored	Scanning time	Number of current values averaged per time unit
500 ms	2000	250 us	8 / 2 ms
1 s	4000	250 us	16 / 4 ms
2 s	4000	500 us	16 / 8 ms
4 s	4000	1 ms	16 / 16 ms
8 s	4000	2 ms	16 / 32 ms
16 s	4000	4 ms	16 / 64 ms
32 s	4000	8 ms	16 / 128 ms
64 s	4000	16 ms	16 / 256 ms

In order to protect the hardware of the Analyzer K1404 and of the device under test, the following values are set for current limitation during and after the current measurement relative to the current measuring range:

Current measuring range	Preset current limitation during measurement (duration $\leq 4$ s)	Preset current limitation during or after measurement (duration $\geq 8$ s)
0..100 mA	ca. 109 mA	ca. 55 mA
0..50 mA	ca. 83 mA	ca. 55 mA
0..10 mA	ca. 46 mA	ca. 46 mA
0..2 mA	ca. 46 mA	ca. 46 mA
0..500 $\mu$ A	ca. 2 mA	ca. 2 mA

Within the measuring range 0..500  $\mu$ A the measuring resistor 250  $\Omega$  is switched on the module L110. In this case, the actual line resistor is 240  $\Omega$  larger than the value given in the LINE RESISTOR menu. As a result, the voltage drop over the line resistance in this current measuring range is  $\approx 120$  mV (240  $\Omega$  x 500  $\mu$ A).

If LINE RESISTOR: OFF and MEASURING RANGE 0...500  $\mu$ A are selected, a line resistor of approx. 253  $\Omega$  results due to the measuring resistor (250  $\Omega$ ). In the case of any other measuring range and the same LINE RESISTOR: OFF setting, a line resistor of approx. 13  $\Omega$  results, since a measuring resistor of 10  $\Omega$  is switched.

Start the measurement via the START/STOP key! First, the measuring panel and the module L110 are initialized. Then, the following status message "INIT/START" is displayed.

The actual start of the measurement is indicated by "MEASURE".

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

### Result structure

The result is displayed during the measurement as follows:

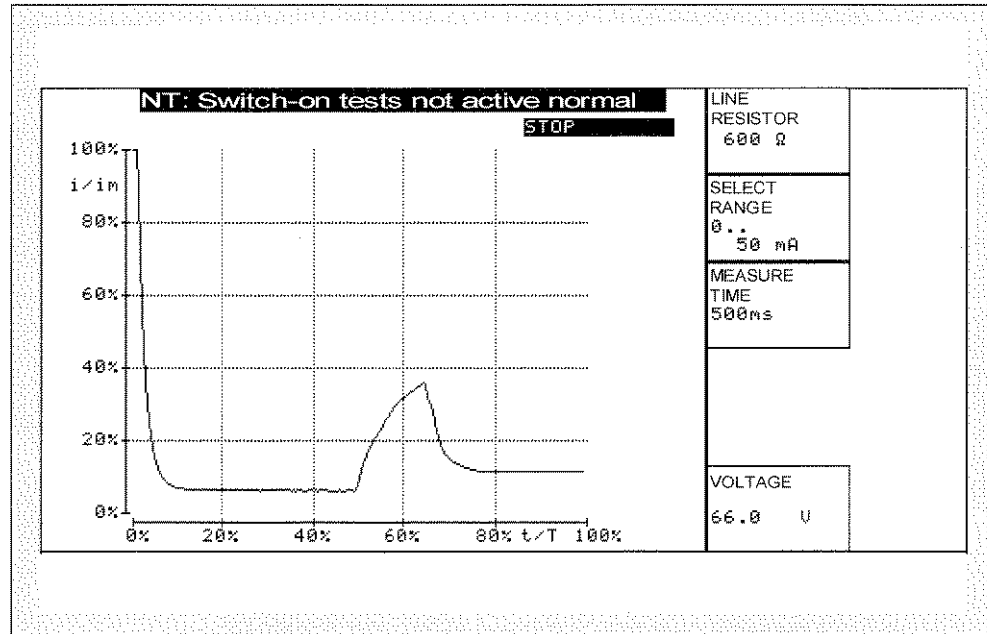


Fig. 6.9: Result structure of Switch-on test measurement

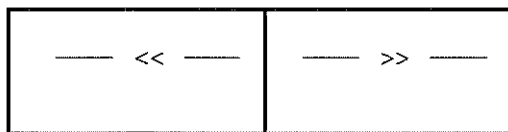
The current peak at the beginning of the measurement effects the charging of a filter capacitor (1  $\mu\text{F}$ ) on the baseplate of the Analyzer K1404. The value and duration of this current depends on the voltage and on the line resistor.

In the result mode (RESULT key), a detailed viewing of the measurement characteristics is possible after stopping the measurement (STOP key). The measurement results can be displayed numerically pixel by pixel using the cursor (vertical bar).

Measured values are displayed in the following form

Time: +500.0 ms	Curr.: +26.18 mA
-----------------	------------------

By touching the required frequency range the cursor can be moved roughly on the x-axis. It is also possible to move pixel by pixel to the left or right using the cursor keys displayed.



## 6.3 Power condition

If you touch the panel POWER FEEDING TESTS LT in the basic menu the working menu appears for the measurement of power feeding characteristics at the LT. The option MEASUREMENTS (LT) : POWER CONDITION is preset.

First, adjust the parameters to your test setup and to the device under test.

		LOAD CUR. MINIMUM	CURRENT STEP
		0.5 mA	0.5 mA
		LOAD CUR. MAXIMUM	TIME OF CUR.STEP
		45.0 mA	0.1 s
MEASUREMENT (LT) POWER CONDITION	CONTROL DEACTIVATION		

### CONTROL

#### ACTIVATION

Measurements are performed at the activated LT.

#### DEACTIVATION

Measurements are performed at the deactivated LT.

### LOAD CURRENT MINIMUM

The minimum load current for loading the device under test (LT) can be directly selected (0.5 mA) or set via the EDIT panel: you can choose settings between 0.5 mA and 100 mA.

### LOAD CURRENT MAXIMUM

The maximum load current for loading the device under test (LT) can be directly selected (10 mA, 45 mA) or set via the EDIT panel: you can choose a setting between 1 mA and 100 mA.

### CURRENT ALT. $\Delta I$

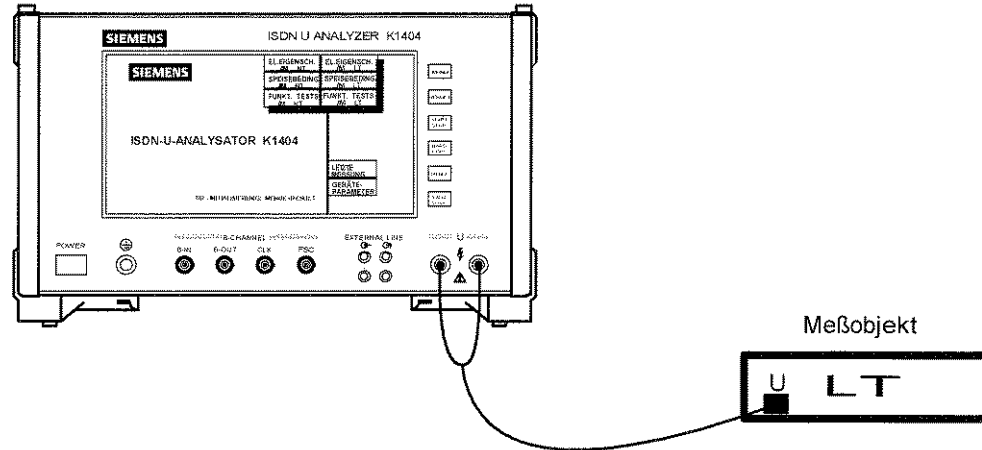
The steps by which the load current is to be increased can be directly selected (0.5 mA, 5 mA) or set via the EDIT panel: you can choose a setting between 0.5 mA and 10 mA.



## DURATION OF $\Delta I$

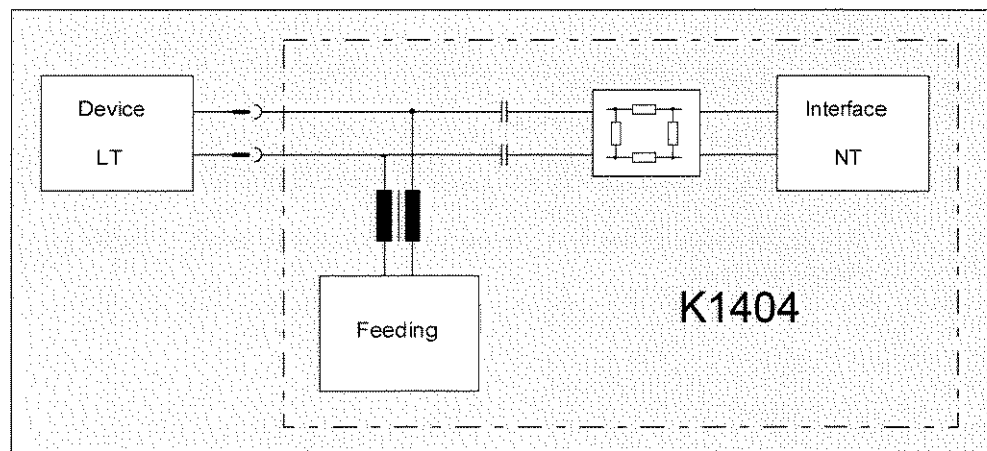
Duration of the power condition measurement for each current load: the value of the desired measurement duration can be directly selected (0.1 s or 1 s) or set via the **EDIT** panel. You can choose a setting between 0.1 s and 10 s.

## Test set-up



## Measurement

The measured quantities are the supply current and voltage of the LT. The device under test is either activated or deactivated. The measurement itself is carried out as follows:



If the menu setting **CONTROL ACTIVATION** is selected, the LT is activated after the start of the measurement. Once the minimum current load is set, the current load is increased step by step up to its maximum value while the measurement duration remains constant. Minimum load, maximum load, current alteration and measurement duration can be edited.

For every load setting, both voltage and current (scanning frequency 500 Hz) are measured during the time given in **MEASUREMENT DURATION**. The power condition is averaged on the basis of 50 ms. For every load setting the minimum value of the output power is determined. Preceding a load increase, this minimum value is compared to the power value established up to then. The higher value will be processed further. After the maximum current load has been reached, the maximum value of the power condition which has been established as indicated as well as the corre-

sponding current and voltage values are displayed on the screen. Approx. every two seconds updated values are displayed. The internal resistor of the power feeding reactor is accounted for in the calculation of the power condition.

If a LT voltage below 5 V is determined after the start of the measurement an error message will be given. In this case the measurement will not be carried out. If the LT voltage drops below 5 V during the measurement or if the LT cannot drive the current load, the measurement will be aborted.

Start the measurement via the START/STOP key! First, the measuring panel and the module L110 are initialized. Then, the following status message "INIT/START" is displayed.

The actual start of the measurement is indicated by "MEASURE".

Abort the measurement via the START/STOP key. The status message "STOP" will appear in the display.

**Result structure**

LT: Power Condition P= 817.E-3 W I= 14.0E-3 A U= 58.5 U  <b>Pmax= 2.54 W</b> I(Pmax)= 44.9E-3 A U(Pmax)= 56.4 U  Cycles: 002		STOP	LOAD CUR. MINIMUM 1.0 mA	CURRENT STEP 1.0 mA
			LOAD CUR. MAXIMUM 45.0 mA	TIME OF CUR. STEP 0.1 s
MEASUREMENT <LT> POWER CONDITION	CONTROL DEACTIVATION			

After completion of the first measurement cycle the result is displayed and permanently updated.

## 7 Functional tests

If you touch the panel **FUNCTIONAL TESTS** in the basic menu the working menu appears for the functional tests. The option **MEASUREMENTS: FREQUENCY SHIFTING** is preset.

If you touch the panel **MESUREMENTS: FREQUENCY SHIFTING** a selection window appears showing the available modes of measurement. You may now select the desired mode of measurement.

					FREQUENCY SHIFTING	DATA CONT. B1	CLOCK INTERNAL
					SHORT TIME INTERRUPTION	RX:INT. TX:INT.	
					CLOCK ACCURACY	BIT ERRORS	
						OFF	
						PN PATTERN 211-1	
						ERRORS NO	START OF FREQU. 0 PPM
MEASUREMENT (NT) FREQUENCY SHIFTING	CONTROL DEACTIVATION	TERMINATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER OFF	



The descriptions of the individual measurements are structured as follows:

First the application routines for **NT** measurements are described. This is followed by a description of the application routines for **LT** measurements. To avoid redundancies, this so-called Delta description focuses only on those features which are different from the NT variant.

## 7.1 Frequency shifting

If you touch the panel FUNCTIONAL TESTS in the basic menu the working menu appears for the functional tests. The option MEASUREMENTS: FREQUENCY SHIFTING is preset.

					DATA CONT. B1 RX: INT. TX: INT.	CLOCK INTERNAL
					BIT ERRORS ON	
					PN PATTERN 2 <sup>11</sup> -1 ERRORS NO	START OF FREQU. 0 PPM
MEASUREMENT (NT) FREQUENCY SHIFTING	CONTROL ACT. LOOP 1	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER OFF

Depending on the codes  $U_{2B1Q}$ ,  $U_{4B3T}$  or  $U_p$  set in the SETUP menu, different menus for the control are opened.

### $U_{2B1Q}$ code

#### CONTROL

If you touch this panel, another menu will be opened in which you can select the available controls of layer 1:

ACT. DOWNSTRM.	DEACTIVATION
ACT. UPSTREAM	DEACT. +ACT.
ACT. LOOP 1	U ONLY ACT.
SINGLE PULSES	

#### ACT. DOWNSTRM.

Activation downstream triggered by the LT, i.e. K1404.

#### ACT. UPSTREAM

Activation upstream: K1404 (LT) is ready for an activation triggered by the device under test (NT).

ACT. LOOP 1

Activation of the test loop 1: The loop is closed directly in the chip of the LT at the U interface. Thus, all channels (B1+B2+D) are looped back. Data from the NT is ignored. The loop signal is present in transparent form at the U sockets.

SINGLE PULSES

The measuring device sends single pulses (SSP).

DEACTIVATION

Decay of layer 1 transmission.

DEACT.+ ACT.

Deactivation followed by activation: the deactivation/activation sequence is controlled via a negative pulse.

You can carry out a timed deactivation and a following activation via an external source with a control via the B - IN socket at the front of the K1404. The control takes place via a sinusoidal or square-wave signal with a frequency of approx. 64 kHz with TTL level.

Control:

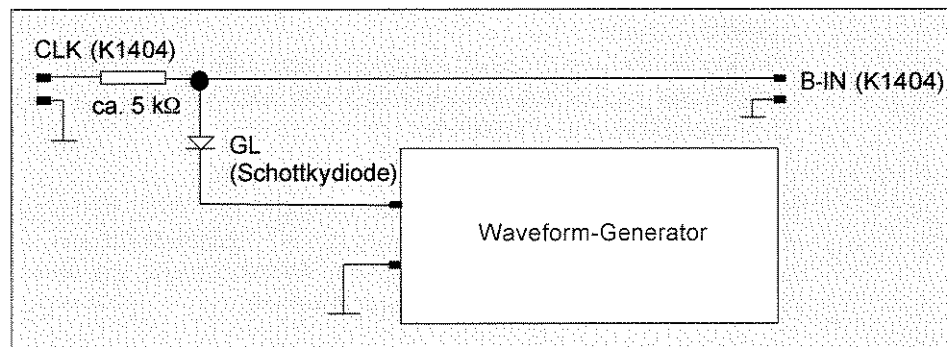
Signal           ⇒     Activation  
 No signal       ⇒     Deactivation

Trigger output (module „Functional Test“):

Selection: TRIGGER „CIC“:

High Level      ⇒     Activation  
 Low Level      ⇒     Deactivation

Control circuit:



With the waveform generator the 64 kHz clock (BNC socket CLK at the front of the K1404) at the B - IN socket is switched on and off. A logic level L corresponds to 0 V and a logic level H to 5 V at the waveform generator. An L (no signal) starts a deactivation and an H (signal) starts the activation. When there is a very short positive pulse (too short period of time for a complete activation), the activation is aborted by a reset of the IEC module. This process is indicated in a trace line in the display.

Of course, instead of this control you can also use a waveform generator, whose signal (approx. 64 kHz/ 5 V logic level) you can switch on and off in a defined way.

U ONLY ACT.

Only the U interface of an NT is activated.

ACT. DOWNSTRM., ACT. UPSTREAM, DEACT.+ ACT. and U ONLY ACT. allow for an EOC control of the device under test (NT). When touching one of these panels, the menu point CONTROL will be linked with the additional function EOC-FCT:

CONTROL -->
EOC FUNCTIONS -->
EOC ADDRESS

EOC-FCT.

If you touch this panel, a menu appears showing the available functions:

LOOP 2 2B+D	NOTIFY C.CRC
LOOP 2 B1	RET. TO NORM.
LOOP 2 B2	HOLD-CMD.
CORRUPTED CRC	
REQUEST C.CRC	EDIT EOC-INFO

LOOP 2 2B+D

Closing of test loop 2 (2B+D loop back, complete loop back). The measuring device K1404 causes the device under test (NT) to close a loop for all channels (B1+ B2+ D) via the U interface.

LOOP 2 B1

Closing a partial test loop in the device under test (NT) (B1 channel loop back). Only channel B1 is looped back from the NT, channels B2 and D continue to operate normally. The measuring device K1404 causes the device under test to close a loop for channel B1 via the U interface.

LOOP 2 B2

Closing a partial test loop in the device under test (NT) (B2 channel loop back). Only channel B2 is looped back from the NT, channels B1 and D continue to operate normally. The measuring device K1404 causes the device under test to close a loop for channel B2 via the U interface.

CORRUPTED CRC

Test of block error recognition in the device under test (NT). The measuring device (LT) transmits a corrupted CRC message to the device under test. If the device under test recognizes a block error, there is a corresponding feedback message to the LT. The far-end block error counter of the LT keeps counting.

REQUEST C. CRC

Request whether the device under test (NT) can transmit corrupted CRC information. The device under test is caused to transmit a corrupted CRC message via the U interface. The near-end block error counter of the LT keeps counting.

NOTIFY C. CRC

Test of the block error recognition in the device under test (NT). The measuring device (LT) transmits a corrupted CRC message to the device under test. If the device under test recognizes a block error, there is a corresponding feedback message to the LT. The far-end block error counter of the LT is counted, the block error counter of the device under test, however, is not counted.

RET. TO NORM

Return to normal operation.

HOLD CMD.

This command is sent by the LT to hold the NT1 EOC counter and other active operations controlled by the EOC in their current state.

EDIT EOC INFO (SW V 6.0)

After touching this panel a window is opened to enter a binary command ( 8 BIT) in the EOC channel.

EOC-ADDRESS (SW V 6.0)

When touching this panel a menu appears to enter the EOC address 0-7 to which the EOC command is sent.

				7	8	9		TAKT	
				4	5	6	BREAK	INTERN	
				1	2	3			
				0					
								START FREQUENZ 0 PPM	
<div style="border: 1px solid black; padding: 5px; width: fit-content;">                 EOC ADRESSE                  ■                  0 «» 7             </div>									
MESSARTEN (NT) FREQUENZ- VERSATZ	STEUERUNG AKT.DOWNSTRM. EOC-FKT. /00 00000000 BIN	ABSCHLUSS 135 Ω	VERB. M.OBJ. DIREKT	S0 AUS	TRIGGER U-RAHMEN	SPEISUNG OHNE			

**U<sub>4B3T</sub> code**

## CONTROL

If you touch this panel, another menu will be opened in which you can select the available controls of layer 1:

ACT. DOWNSTRM.	DEACTIVATE
ACT. UPSTREAM	DEACT. + ACT.
ACT. LOOP 1	
ACT. LOOP 2	
ACT. LOOP 4	SINGLE PULSES

## ACT. DOWNSTRM.

Activation downstream triggered by the LT, i.e. K1404.

## ACT. UPSTREAM

Activation upstream: K1404 (LT) is ready for an activation triggered by the device under test (NT).

## ACT. LOOP 1

Closing of test loop 1: The loop is closed directly in the chip of the LT at the U interface. Thus, all channels (B1+B2+D) are looped back. Data from the NT is ignored. The loop signal is present in transparent form at the U sockets.



Prior to the activation with LOOP 1 a ACT. DOWNSTRM. or ACT. LOOP 2 must be carried out.

## ACT. LOOP 2

Closing of test loop 2 (2B+D loop back, complete loop back). The measuring device K1404 causes the device under test (NT) to close a loop for all channels (B1+ B2+ D) via the U interface.

## ACT. LOOP 4

Closing of test loop 4 in an intermediate generator (2B+D loop back, complete loop back). The K1404 causes the device under test (ZWR), to close a loop for all channels (B1+ B2+ D) via the U interface.

## SINGLE PULSES

The measuring device sends single pulses (SSP).

## DEACTIVATION

Decay of layer 1 transmission.

## DEACT. + ACT.

Deactivation followed by activation: the deactivation/activation sequence is controlled via a negative pulse.



**U<sub>P0</sub> code**

## CONTROL

If you touch this panel, another menu will be opened in which you can select the available controls of layer 1:

ACT. DOWNSTRM.	DEACTIVATE
ACT. UPSTREAM	DEACT. + ACT.
ACT. LOOP 1	CONTINUOUS PULSES
ACT. LOOP 2	SINGLE PULSES

## ACT. DOWNSTRM.

Activation downstream triggered by the LT, i.e. K1404.

## ACT. UPSTREAM

Activation upstream: K1404 (LT) is ready for an activation triggered by the device under test (NT).

## ACT. LOOP 1

Activation of the test loop 1: The loop is closed directly in the chip of the LT at the U interface. Thus, all channels (B1+B2+D) are looped back. Data from the NT is ignored. The loop signal is present in transparent form at the U sockets.

## ACT. LOOP 2

Closing of test loop 2 (2B+D loop back, complete loop back). The measuring device K1404 causes the device under test (NT) to close a loop for all channels (B1+ B2+ D) via the U interface.

## DEACTIVATION

Decay of layer 1 transmission.

## DEACT. + ACT.

Deactivation followed by activation: the deactivation/activation sequence is controlled via a negative pulse.

## CONTINUOUS PULSES

The measuring device sends continuous pulses (frequency: 192 kHz)

## CONTINUOUS PULSES

The measuring device sends single pulses (SSP).

## TERMINATION

Adjusting the analyzer to the device under test: Selection 135  $\Omega$  / 150  $\Omega$  at U<sub>2B1Q</sub> and U<sub>4B3T</sub> interfaces. For the U<sub>P0</sub> interface 100  $\Omega$  is preset .

## CONN. W. OBJ.

Connection with the device under test: Connection options between the internal U interface and the device under test are indicated. For U2B1Q and Up interface, a change of the setting after STOP is only accepted at START if there is an additional deactivation. For U4B3T the chosen setting is accepted without deactivation at START.

DIRECT
ATTENU- ATION
EXT. LINE
EXT.L. +PWR.

## DIRECT

The U interface is directly connected with the U sockets on the front panel.

ATTENUATION (NOT FOR U<sub>PO</sub> INTERFACE)

Between the U interface and the U sockets a symmetrical II-divider with 12 dB attenuation is looped through.

## EXT. LINE

The connection between U interface and U sockets is interrupted by the socket pairs EXTERNAL LINE OUT and IN. When an artificial line is connected to these socket pairs, the U signal will be routed without DC voltage content via the artificial line. In this case the feeding voltage is coupled at the U sockets.

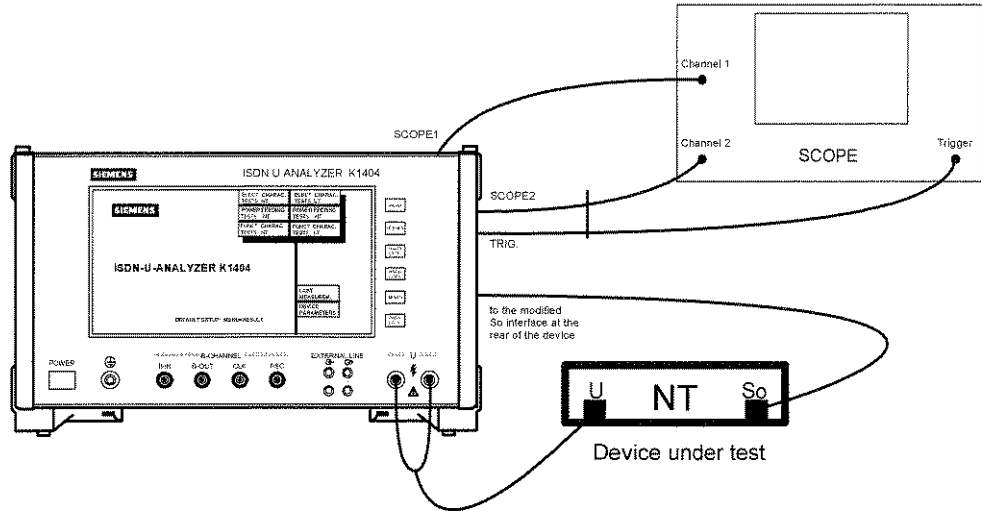
## EXT. L. +PWR.

External line and feeding voltage: One end of the artificial line is directly connected to the U sockets while the device under test (NT) is connected to the other end. The far end can be connected via the sockets EXTERNAL LINE IN: This allows you to observe the layer 1 signal at the device under test.

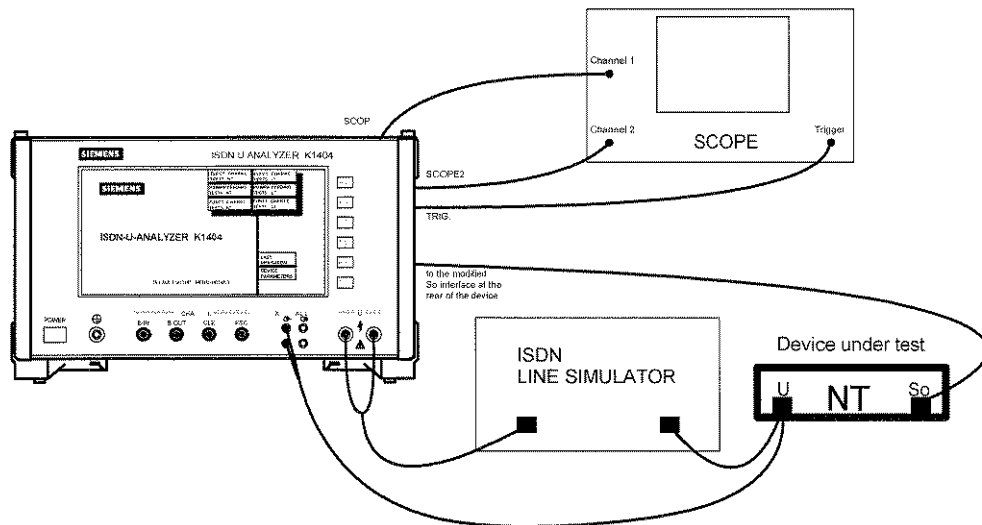
Built-in measuring heads with subsequent buffer and driver amplifiers allow simultaneous observation of the layer 1 setup and operation at the interface and at the device under test (NT). If an attenuator or an artificial line is inserted, the signals pertaining to the LT and NT can be unmistakably distinguished.

Socket SCOPE 1: signals from the NT side, socket SCOPE 2: signals from the LT side, 50 Ω / coaxial (device rear: module L31 slot 1). Trigger signal applied to socket TRIG. (device rear: module L33X slot 4 or 5).

Test set-up



Test set-up for EXT. L. + PWR. (external line and feeding voltage)



S<sub>0</sub>

The internal S<sub>0</sub> interface (modified S<sub>0</sub> interface without load from the measuring device) is switched on or off.

DATA CONT.

The data control menu varies in scope depending on the internal S<sub>0</sub> interface:

S<sub>0</sub> OFF

If the internal S<sub>0</sub> interface is switched off the following data control menu appears:

B1+B2 RX: INT TX: INT	B1 RX: INT TX: INT	B2 RX: INT TX: INT	MON+B* RX: EXT
B1+B2 RX: EXT TX: INT	B1 RX: EXT TX: INT	B2 RX: EXT TX: INT	MON RX: EXT
B1+B2 RX: INT TX: EXT	B1 RX: INT TX: EXT	B2 RX: INT TX: EXT	B* RX: EXT
B1+B2 RX: EXT TX: EXT	B1 RX: EXT TX: EXT	B2 RX: EXT TX: EXT	
			ESC.

S<sub>0</sub> ON

If the internal S<sub>0</sub> interface is switched on, bit measurement is only possible in one of the B channels. No bit error measurement is possible for RX:EXT. The following data control menu will be displayed:

B1 RX: INT TX: INT	B2 RX: INT TX: INT	MON+B* RX: EXT
B1 RX: EXT TX: INT	B2 RX: EXT TX: INT	MON RX: EXT
B1 RX: INT TX: EXT	B2 RX: INT TX: EXT	B* RX: EXT
B1 RX: EXT TX: EXT	B2 RX: EXT TX: EXT	
		ESC.

B1 + B2

Bit error measurement in B1 and B2 (128 kBit/s)

B1

Bit error measurement in B1 only (64 kBit/s)

B2

Bit error measurement in B2 only (64 kBit/s)

RX INT

Data received at U is evaluated by the internal bit error counter.

RX EXT

Data received at U is available at socket B-OUT for external evaluation.

TX INT

Data output to U is created by the internal pattern generator.

TX EXT

Data output to U is read in via the socket B-IN.

MON

Monitor channel of the IOM interface (read only access, 64 kBit/s)

B\*

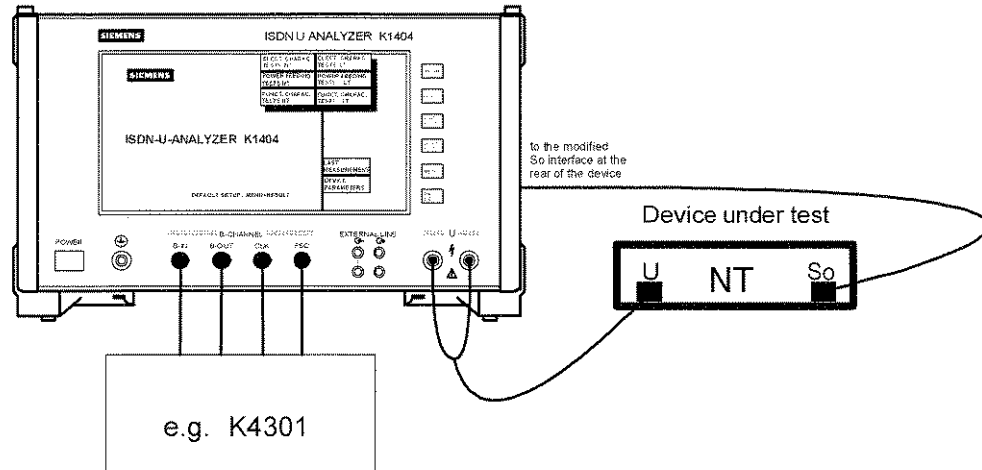
B\* channel of the IOM interface (read only access, 64kBit/s):

2 bits D channel, 4 bits command/indication, 2 bits handshake for monitor channel

TRANSPARENT (ONLY U<sub>2B1Q</sub> INTERFACE)

Data is neither read into nor out of the B channels.

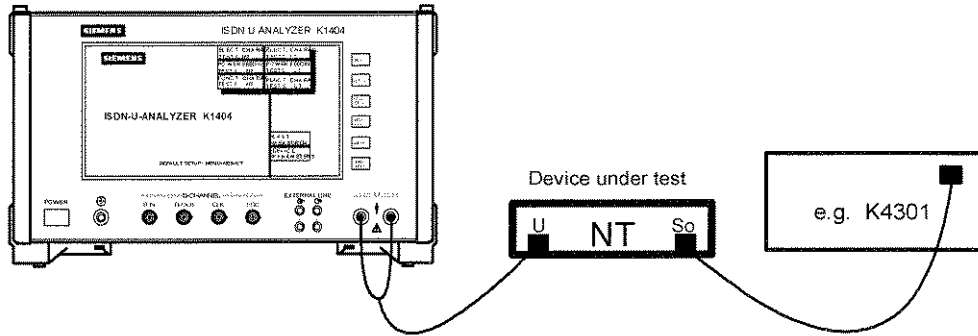
### Test set-up



BIT ERROR MEASUREMENT

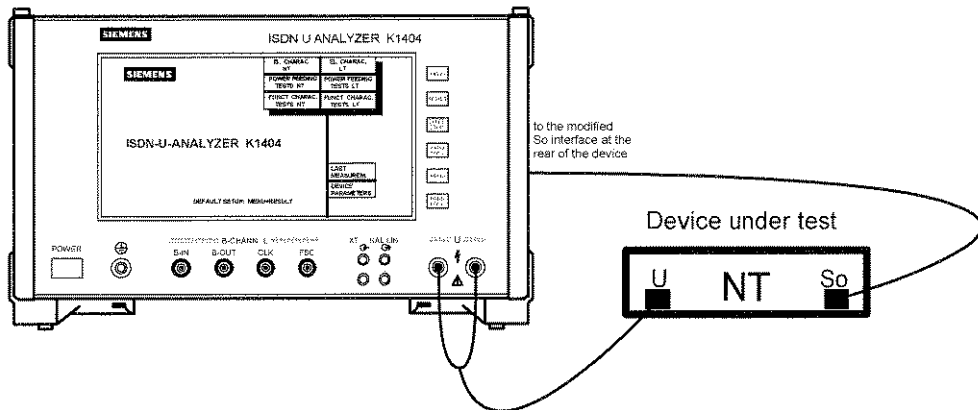
The bit error measurement is switched on or off. As long as the modified  $S_0$  interface is switched off, the data patterns are read into the U interface of the analyzer, or read out by it, and examined.

Test set-up



If the device-specific  $S_0$  interface is active, the data is read into the U interface (LT) and read out by the  $S_0$  interface (TE) downstream, and is read into the  $S_0$  interface (TE) and read out by the U interface (LT) upstream.

Test set-up



For DURATION 0 and DURATION 1 no bit error measurement is implemented.

## PN PATTERN / ERRORS

The following menu is opened showing the bit patterns created by the pattern generator and the possible error rates:

PN PATTERN -->
ERRORS -->

## PN PATTERN

The bit patterns  $2^{20}-1$ ,  $2^{15}-1$ ,  $2^{11}-1$ ,  $2^9-1$  of duration 0 and 1 that are created by the pattern generator can be inserted into the B channels. The selected bit pattern  $2^{20}-1$  to  $2^9-1$  only appears in the data channel if the bit error measurement is switched on. Only CONTINUOUS 0 and CONTINUOUS 1 are transmitted in the selected data channel with the bit error measurement switched off.

$2^{20}-1$	$2^9-1$
$2^{16}-1$	CONT. 0
$2^{11}-1$	CONT. 1

## ERRORS

Errors with error rates of  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-6}$ ,  $10^{-7}$  can be inserted into the bit patterns created by the pattern generator.

NO	$10^{-5}$
$10^{-3}$	$10^{-6}$
$10^{-4}$	$10^{-7}$

## TRIGGER

This function displays the trigger signals which are provided at the socket TRIG. (device rear) by the functional tests module.

NO
U-FRAME
U-CLOCK
CIC

## NO

No trigger signal is output.

## U-FRAME

A negative pulse synchronous to the U superframe at  $U_{2B1Q}$  or synchronous to the U frame at  $U_{4B3T}$  and  $U_{P0}$  is output. This pulse can be used to trigger an oscilloscope externally. The U signals at the sockets SCOPE 1 and SCOPE 2 can be evaluated like that. The moment of triggering may be shifted after the start of the measurement by means of the two trigger keys TR <-- and TR -->. This makes for optimum presentation, e.g. when displaying the sync word of a U frame on the oscilloscope.

## U-CLOCK

The 80 kHz ( $U_{2B1Q}$ ), 120 kHz ( $U_{4B3T}$ ) or 384 kHz ( $U_{P0}$ ) clock is output in synchronization with the U interface.

## CIC

If you have not selected DEACT. + ACT from the menu panel CONTROL: Any status change of layer 1 is indicated by a level change. At the start of an activation the message "High" is output.

If you have selected DEACT. + ACT from the menu panel CONTROL: During the trace line output the message "High" is given to indicate that at this time no control pulse must be applied since otherwise the time values for deactivation and activation would be incorrect. The message "Low" indicates that the device is once more ready for a control pulse.

MOS (ONLY  $U_{2B1Q}$ )

Any monitor status change is indicated by a level change. This is the case if the message "EOC-Acknowledge" is returned, if a change in the overhead bits has occurred or if the near/far-end block error counter is read out. At the start of an activation, the message "High" is output.

## CLOCK

If you touch this panel, a menu appears in which the master clock generation can be set.

INTERNAL
EXTERNAL 2.048 MHz
EXTERNAL 1.536 MHz
JITTER

## INTERNAL

Master clock generation with internal master oscillator.

## EXTERNAL 2.048MHZ

The internal master oscillator is synchronized via a 2.048 MHz signal.

## EXTERNAL 1.536MHZ

The internal master oscillator is synchronized via a 1.536 MHz signal. The external clock signal must be applied to the socket SYST. (device rear).

## JITTER (ONLY ACTIVE WITH MODULE „OPTION JITTER“)

The internal clock can be looped via the sockets CLK-OUT and CLK-IN to jitter the module „Option Jitter“. After activating this panel additional panels are opened to enter the jitter frequency and jitter amplitude.



START FREQUENCY

The shift of the master frequency (15.36 MHz) can be changed in steps of 1 ppm from + 127 to -128. The following editing panel is opened:

Frqu.Shift [ppm]: <b>-125</b> -128 «» +127				7	8	9	CLR	CLOCK
				4	5	6	BREAK	INTERNAL
				1	2	3	RUB	
				0		+/-	ENTER	
						START OF FREQU. 0 ppm		
MEASUREMENT (NT) FREQUENCY SHIFTING	CONTROL ACT.DOWNSTRM. EOC FUNCTIONS REQUEST C.CRC	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	50 Ω	TRIGGER NO	POWER OFF		

The master frequency can also be changed during a measurement by using the arrow keys  $f \leftarrow$  or  $f \rightarrow$ .

POWER

This panel opens another menu in which you can select from the following settings:

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

OFF

The feeding voltage is switched off.

EXTERNAL

The feeding voltage can be routed via sockets U1 and U2 at the rear of the device (feeding, slot 7).

NORMAL

The feeding voltage is applied without additional series resistor.

NORMAL WITH RL

The additional series resistor of 600 Ω simulates a line resistor.

The panels NORMAL or NORMAL WITH RL open the following editing menu:

EDIT
LAST EDIT-VALUE
10 V
32 V
66 V
115 V

**EDIT**

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via EDIT).

The selected feeding voltage will be applied to the U socket after the START key has been activated.

**Measurement**

Start the measurement via the START/STOP key. You will then obtain the following window with the additional event functions:

NT: Funct. Charac. Frequency Shifting					DATA CONT. B1	CLOCK
					RX:INT.	INTERNAL
					TX:INT.	
					DELETE BIT-ERROR	
					PN PATTERN 2 <sup>11</sup> -1	
					ERRORS NO	START OF FREQU. 0 PPM
					BIT-ERROR	
					Tr <--	f <--
					Tr -->	f -->
MEASUREMENT (NT)	CONTROL ACT.DOWNSTRM.	TERMI-NATION 135 Ω	CONT. TO IUT DIRECT	S0 ON	TRIGGER U-FRAME	POWER OFF
FREQUENCY SHIFTING	EOC FUNCTIONS REQUEST C.CRC					

**DELETE BIT ERROR**

The displayed bit errors are deleted, the bit error timer is reset.

**SINGLE BIT ERROR**

A single bit error is inserted into the bit pattern generated internally.

TR <--

The triggering moment of the U FRAME trigger signal is shifted. The display on the oscilloscope is shifted to the left until the TR <-- or TR --> key is pressed again.

TR -->

The triggering moment of the U FRAME trigger signal is shifted. The display on the oscilloscope is shifted to the right until the TR <-- or TR --> key is pressed again.

f <--

In intervals of three seconds the master frequency is decreased in steps of 1 ppm starting with the value set in the menu point START FREQUENCY. This process continues until the minimum value of -128 ppm has been reached or until either the f <-- or f --> key is pressed again.

f -->

In intervals of three seconds the master frequency is increased in steps of 1 ppm starting with the value set in the menu point START FREQUENCY. This process continues until the maximum value of +127 ppm has been reached or until either the f <-- or f --> key is pressed again.

**Result structure**

All functional tests are displayed in trace lines.

**2B1Q interface**

NT: Funct. Charac. Frequency Shifting				DATA CONT. B1+B2	CLOCK	
STOP				RX:INT.	INTERNAL	
001 T1: Awake	004.7 ms	004.7 ms		TX:INT.		
002 T4: SL2 Transmission	333.2 ms	328.5 ms		BIT ERRORS		
003 T7: Full Op. (act=0)	571.5 ms	238.2 ms		ON		
004 Overh. B: 111 111 110 111	607.6 ms	036.1 ms		PH PATTERN 2 <sup>11</sup> -1		
005 Overh. B: 111 111 110 111	619.6 ms	012.0 ms		ERRORS		
006 T7: Full Op. (act=1)	655.2 ms	035.6 ms		NO	START OF FREQU. 0 ppm	
007 Overh. B: 111 111 110 111	676.3 ms	021.1 ms		Tr <--		
BER-U: 0.00000				Tr -->		
BE-U: 0.00000						
TIME: 109.000 s						
NB-counter : 00000	Overhead Bits:					
FB-counter : 00000	act :1 usr1:1 usr2:1					
PPM : 0	ps1 :1 usr3:1 febe:1					
	ps2 :1 ntM :1 cso :0					
	usr4:1 sai :1 nib :1					
MEASUREMENT (NT)	CONTROL ACT. DOWNSTRM.	TERMI-NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER OFF
FREQUENCY SHIFTING	ECC FUNCTIONS RET. TO NORM.					

The trace lines have the following format:

NNN TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT ZZZZZ EEE ZZZZZ EEE

N

Line number, 3 digits: NNN: 001 to 400. Up to 400 trace lines can be recorded. Once a measurement has been terminated via STOP these trace lines may be viewed in the RESULT mode window by scrolling.

T

Trace line text, up to 28 characters. For reasons of space an overview of the trace line texts is given further below.

Z

Time values, 5 digits. The first time value is the time which has elapsed since the start of an activation.

E

Unit of time, max. 3 digits. The second time value is the time difference relative to the preceding event.

The trace lines are displayed in the following format:

xxx.x	us	microseconds
xxx.x	ms	milliseconds
xx.xx	s	seconds
xx:xx	min	minutes
xx:xx	h	hours

Maximum total time: 18:12 h.

The following table offers an overview of the trace line texts of the 2B1Q interface and their description:

T1: Awake	ANSI timestep T1: LT and NT are awake
T4: SL2 Transmission	ANSI timestep T4: LT sends SL2 signal
T7: Full Op. (act=0)	ANSI timestep T7: Layer 1 is activated, activation bit = 0
T7: Full Op. (act=1)	ANSI timestep T7: Layer 1 is activated, activation bit = 1; layer 2 could be activated
EOC-Com: L-2 2B+D Adr: a	EOC command: Close LOOP 2 with 2B + D (close complete loop back 2), EOC address a (a = 0 ... 7)
EOC-Com: L-2 B1 Adr: a	EOC command: Close LOOP 2 with B1 (close partial loop back 2), EOC address a (a = 0 ... 7)
EOC-Com: L-2 B2 Adr: a	EOC command: Close LOOP 2 with B2 (close partial loop back 2), EOC address a (a = 0 ... 7)
EOC-Com: Req. CCRC Adr: a	EOC command: Request of corrupted CRC. The NT or repeater is requested to send corrupted CRC. EOC address a (a = 0 ... 7)
EOC-Com: Not. CCRC Adr: a	EOC command: Notify of corrupted CRC. The NT or repeater is notified of the subsequent transmission of corrupted CRC EOC address a (a = 0 ... 7)
EOC-Com: R.to Norm. Adr: a	EOC command: Return to normal. All previous EOC commands are cleared. EOC address a (a = 0 ... 7)
Transmission of Corr. CRC	K1404 (LT) sends corrupted CRC
EOC-Ack: L-2 2B+D Adr: a	NT or repeater has acknowledged 'EOC-COM: L-2 2B+D'. EOC address a (a = 0 ... 7)
EOC-Ack: L-2 B1 Adr: a	NT or repeater has acknowledged 'EOC-COM: L-2 B1'. EOC address a (a = 0 ... 7)
EOC-Ack: L-2 B2 Adr: a	NT or repeater has acknowledged 'EOC-COM: L-2 B2'. EOC address a (a = 0 ... 7)
EOC-Ack: Req. CCRC Adr: a	NT or repeater has acknowledged 'EOC-COM: Rep. CCRC'. EOC address a (a = 0 ... 7)
EOC-Ack: Not. CCRC Adr: a	NT or repeater has acknowledged 'EOC-COM: NOT. CCRC'. EOC address a (a = 0 ... 7)
EOC-Ack: R.to Norm. Adr: a	NT or repeater has acknowledged 'EOC-COM: R.to Norm'. EOC address a (a = 0 ... 7)
EOC-Ack: U.to comp. Adr: a	NT or repeater cannot carry out EOC-COM. EOC address a (a = 0 ... 7)
EOC-Ack: Hold Adr: 0	NT reports receipt of a wrong EOC address (a = 1 ... 6) and returns its own address.
EOC-Ack: aaa d iiii iiii	An EOC acknowledgement not defined in ANSI or ETSI has been received: aaa: 3 bits EOC address 0 to 7 binary; d: 1 bit data / message indicator; iiii iiii: 8 bits information

Deactivation accepted	U component has received request for deactivation and initiates deactivation
deactivated	Layer 1 is deactivated
Act.-break by IEC-Q Reset	Activation was disrupted via IEC-Q reset (when Control Deact + Act is selected))
Overh. B: xxx xxx xxx xxx	All overhead bits are displayed at the positions M4, M5 and M6 (without CRC!) in the order of their transmission in the super frame. Presentation in ternary groups corresponds to the display of overhead bits in the lower display area.
Loop 1 closed	LOOP 1 in LT is closed
Send Single Pulses	K1404 sends single pulses
S0 activated	S0 is activated (when measurements are performed at the NT; S0 = TE)
S0 not activated	S0 is not activated (when measurements are performed at the NT; S0 = TE)
Error on U	Error on U interface
Error on S0	Error on S0 interface of the NT
Error on U (Timeout, 15s)	Error on U interface, 15 s timer has run out, activation is not possible!
Far-End-Counter Overflow	Overflow of far-end-block error counter
Near-End-Counter Overflow	Overflow of near-end-block error counter
Loss Of Synchronisation	Loss of synchronisation on U
Loss Of Signal	No more signal present on U
BE-U: AIS	Bit error measurement at U: Alarm indication signal. Receipt of duration '1'
BE-U: Continuous Zero	Bit error measurement at U: Continuous zero. Receipt of duration '0'
BE-U: Bitslip	Bit error measurement at U: Bitslip. Bit error measurement is asynchronous
BE-U: run	Bit error measurement at U is running
BE-S0: AIS	Bit error measurement at S0: Alarm indication signal. Receipt of duration '1'
BE-S0: Continuous Zero	Bit error measurement at S0: Alarm indication signal. Receipt of duration '0'
BE-S0: Bitslip	Bit error measurement at S0: Bitslip. Bit error measurement is asynchronous
BE-S0: run	Bit error measurement at S0 is running
Trace-Buffer full	Trace-buffer is full. Max. number of trace lines (400) has been reached.

## Further results for

## - BIT ERROR MEASUREMENT = ON

BER-U: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-U: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface
TIME: <time>	Time taken for calculating the bit error rate

## - S0 = ON

BER-S0: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-S0: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface

## - NB-COUNTER

Near-end block error counter	Incremented if a block error has occurred in the transmission from the device under test to K1404.
Near-end-block error	The CRC calculated in K1404 does not correspond to the CRC as received.

## - FB-COUNTER

Far-end block error counter	Incremented if a block error has occurred in the transmission from the device under test to K1404.
Far-end block error	The CRC calculated in K1404 does not correspond to the CRC as received. In the subsequent super frame the device under test will set the far-end block error bit (febe) to '0' with the result that the far-end block error counter is raised in K1404.

## - PPM

The actual shift of the master frequency compared to the nominal value 15.36 MHz is displayed in ppm.

### - Overhead Bits

The overhead bits are displayed in the order in which they are received at the U interface. The four lines containing 3 bits each correspond to a ternary group in the trace line presentation of the overhead bits, i.e. when measurements are performed at the NT:

1st Ternary group:	act	usr1	usr2
2nd Ternary group:	ps1	usr3	febe
3rd Ternary group:	ps2	ntm	cso
4th Ternary group:	usr4	sai	nib

#### 1st group

act      Activation bit (=1, if ready for layer 2 activation)  
 usr1     User bit 1 (reserved for future applications)  
 usr2     User bit 2 (reserved for future applications)

#### 2nd group

ps1      Power status bit 1 (=1, if primary power supply is present: line voltage)  
 usr3     User bit 3 (reserved for future applications)  
 febe     Far-end block error bit (=0, if a block error has occurred in the direction of reception. This means that at the remote terminal the far-end block error counter is raised)

#### 3rd group

ps2      Power status bit 2 (=1, if secondary power supply is present, e.g. accumulator)  
 ntm      NT in test mode (=0, if the NT is in test mode)  
 cso      Cold Start Only (=1, if the NT can carry out cold starts only)

#### 4th group

usr4     User bit 4 (reserved for future applications)  
 sai      S activation indicator (=1, if INFO1 or INFO3 to S<sub>0</sub>)  
 nib      Network indicator bit (always 1, since currently not used, see ANSI or ETSI)



**Error messages**

L3Q: Switchb. error	Error in the setting of the measuring panel for functional test
L3Q: Setup error	Error in the setting of the module Functional Tests (e.g. wrong setting parameter)
L3Q: Handsh. T-out	Timeout for result output to HOST has occurred. No results are output. However, no results are lost as they are accounted for at the next output.
L3Q: Status error	Error in the status output to the HOST.
L3Q: Eventkey error	A wrong key information for the event keys has been transferred by the HOST.
L3Q: Act. failed	No activation within a timeout of 20 s, i.e. even the built-in layer 1 component of K1404 does not react. Try to activate once more!
L3Q: No MON-Command	Due to an internal error no monitor command could be transmitted, i.e. no EOC commands are output nor are block error counters read out. Deactivate and activate once more! In case of repeated occurrence of this error switch the device off and on.
L3Q: Data in error	Error in the data transfer from HOST to module
L3Q: Data out error	Error in the data transfer from module to HOST
L3Q: Host Com. error	Wrong command output to module by HOST
L3Q: NO RESP	Module Functional Tests does no longer react. Switch the device off and on again!
Timeout START again	The module has failed to report readiness to the HOST in time and is therefore reset. Start again!

After a measurement has been terminated via STOP you can call up the **Result mode** via the RESULT key. You will then obtain the scroll keys TR\* and TR\* which allow you to shift the trace lines backwards and forwards.

TR <--

Scroll backwards: trace lines are shifted in downward direction.

TR -->

Scroll forward: trace lines are shifted in upward direction..

Exit the result mode by repeatedly pressing the RESULT key.

**4B3T interface**

NT: Funktionale Tests Frequenzversatz 4B3T STOP					DATA CONT. B1 RX: INT. TX: INT.	TAKT INTERN
001 SIG 0: deactivated	000.0 us	000.0 us			BITFEHLER MESSUNG AUS	START FREQUENZ 0 ppm
002 SIG 0: deactivated	375.0 us	000.3 ms				
003 SIG 2W: Line awake	750.0 us	000.3 ms				
004 SIG 1: Sync. upstream	673.8 ms	673.1 ms				
005 SIG 4: Line active	675.8 ms	002.0 ms				
RDS-counter : 00000 PPM : 0					PN MUSTER 211-1 FEHLER KEIN	
MESSARTEN (NT) FREQUENZ- VERSATZ	STEUERUNG AKT.DOWNSTRM.	ABSCHLUSS 150 Ω	VERB. M.OBJ. DIREKT	S0 AUS	TRIGGER U-RAHMEN	SPEISUNG NORMAL 66.0 V

The trace lines have the following format:

NNN TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT ZZZZZ EEE ZZZZZ EEE

N

Line number, 3 digits: NNN: 001 to 400. Up to 400 trace lines can be recorded. Once a measurement has been terminated via STOP these trace lines may be viewed in the RESULT mode window by scrolling.

T

Trace line text, up to 28 characters. For reasons of space an overview of the trace line texts is given further below.

Z

Time values, 5 digits. The first time value is the time which has elapsed since the start of an activation.

E

Unit of time, max. 3 digits. The second time value is the time difference relative to the preceding event.

The trace lines are displayed in the following format:

- xxx.x us      microseconds
- xxx.x ms      milliseconds
- xx.xx s       seconds
- xx:xx min     minutes
- xx:xx h       hours

Maximum total time: 18:12 h.

The following table offers an overview of the **trace line texts of the 4B3T interface** and their description:

SIG 0: Deact. Ac-knowledge	Acknowledgement of deactivation
SIG 0: deactivated	The line is deactivated
SIG 2W: Line awake	K1404 (LT) sends U signal 2W
SIG 1: Sync. upstream	K1404 (LT) has received U signal 1
SIG 4: Line active	K1404 (LT) sends U signal 4
SIG 2W: Line awake (L. #1)	K1404 (LT) sends U signal 2W (request for loop 1)
SIG 2W: Line awake (L. #2)	K1404 (LT) sends U signal 2W (request for loop 2)
SIG 2W: Line awake (L. #4)	K1404 (LT) sends U signal 2W (request for loop 4 (loop in repeater))
SIG 4H: Resync. upstream	K1404 (LT) sends U signal 4H (LT has lost synchronization in active state)
RDS-Counter Overflow	Running digital sum counter has overflown
Send Single Pulses	K1404 sends single pulses
Act.-break by IEC-T Reset	Activation was aborted by RESET of the IEC-T (in case of control: Deact + Act)
Loss Of Signal	No more signal to U
BE-U: AIS	Bit error measurement at U: alarm indication signal. Receiving duration '1'
BE-U: Continuous Zero	Bit error measurement at U: continuous zero. Receiving duration '0'
BE-U: Bitslip	Bit error measurement at U: bitslip. Bit error measuring device is asynchronous
BE-U: run	Bit error measurement at U is running
BE-S0: AIS	Bit error measurement at S0: alarm indication signal. Receiving duration '1'
BE-S0: Continuous Zero	Bit error measurement at S0: Receiving duration '0'
BE-S0: Bitslip	Bit error measurement at S0: bitslip. Bit error measuring device is asynchronous
BE-S0: asynchron	Bit error measurement at S0: Receiver is asynchronous BER>0.3
BE-S0: run	Bit error measurement at S0: bit error measurement is running
S0 activated	S0 (TE) is activated
S0 not activated	S0 (TE) is not activated
S0 no sync or lost frame	S0 (TE) is asynchronous or loss of frame
Trace-Buffer full	Trace-buffer is full. Max. number of trace lines (400) was reached.

## Further results for

- BIT ERROR MEASUREMENT = ON

BER-U: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-U: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface
TIME: <time>	Time taken for calculating the bit error rate

- S0 = ON

BER-S0: <error rate>	Bit error rate of the bit error measurement at the S0 interface
BE-S0: <error sum>	Sum of the bit errors accrued in the bit error measurement at the S0 interface

- RDS-COUNTER

Running Digital Sum Counter	Is increased if a block error occurred in the transmission
-----------------------------	--

- PPM

The actual shift of the modulation rate in ppm is displayed.

**Error messages**

L3T: Switchb. error	Error in the setting of the measuring panel for functional tests
L3T: Setup error	Error in the setting of the module Functional Tests (e.g. wrong setting parameters)
L3T: Handsh. T-out	Timeout for result output to HOST has occurred. No results are output. However, no results are lost as they are accounted for at the next output.
L3T: Status error	Error in the status output to the HOST
L3T: Eventkey error	A wrong key information for the event keys has been transferred by the HOST.
L3T: Act. failed	No activation within a timeout of 20 s, i.e. even the built-in layer 1 component of K1404 does not react. Try to activate once more!
L3T: deactivated	L331 is deactivated (this message appears in other types of measurement (e.g. Power Spectral Density) in case of L331 service.)
L3T: Error on U	Error at the U interface (this message appears in other types of measurement (e.g. Power Spectral Density) in case of L331 service.)
L3T: Data in error	Error in the data transfer from HOST to module
L3T: Data out error	Error in the data transfer from module to HOST
L3T: Host Com. error	Wrong command output to module by HOST
L3T: NO RESP	Module Functional Tests does no longer react. Switch the device off and on again!
L3T: L331 HW: 1.0	Measurement of the clock accuracy with single pulses is not possible with HW 1.0
L3T: S0 not active	S0 (TE) is not activated (this message is indicated at the NT in case of jitter measurement)
Timeout START again	The module has failed to report readiness to the HOST in time and is therefore reset. Start again!
Trace-Buffer full	Trace-buffer is full. Max. number of trace lines (400) was reached.

After a measurement has been terminated via STOP you can call up the **Result mode** via the RESULT key. You will then obtain the scroll keys TR <-- or TR --> which allow you to shift the trace lines backwards and forwards.

TR <--

Scroll backwards: trace lines are shifted in downward direction.

TR -->

Scroll forward: trace lines are shifted in upward direction..

Exit the result mode by repeatedly pressing the RESULT key.



The following table offers an overview of the **trace line texts of the U<sub>po</sub> interface** and their description:

Deactivate Acknowledge	Measurement at the NT: request for deactivation acknowledged
deactivated	The line is deactivated
Timeout Act/Deact	Software-timeout at the start of the deactivation or the deactivation has expired. Activation or deactivation has failed
LOOP #1 closed	Measurement at the NT: Loop L1 is closed
BE-U: AIS	Bit error measurement at U: <u>A</u> larme <u>I</u> ndication <u>S</u> ignal, receiving duration '1'
BE-U: Continuous Zero	Bit error measurement at U: receiving duration '0'
BE-U: Bitslip	Bit error measurement at U: bitslip. Receiver is asynchronous
BE-U: run	Bit error measurement at U: Bit error measurement is running
BE-U: asynchron	Bit error measurement at U: Receiver is asynchronous BER > 0.3
BE-S0: AIS	Bit error measurement at S0: <u>A</u> larme <u>I</u> ndication <u>S</u> ignal, receiving duration '1'
BE-S0: Continuous Zero	Bit error measurement at S0: receiving duration '0'
BE-S0: Bitslip	Bit error measurement at S0: bitslip. Receiver is asynchronous
BE-S0: run	Bit error measurement at S0: Bit error measurement is running
BE-S0: asynchron	Measurement at the NT: request for activation for loop 1
S0 activated	Measurement at the NT: activation of loop 1 is terminated
S0 not activated	Measurement at the NT: S0 (TE) is not activated
S0 no sync or lost Frame	Measurement at the NT: S0 (TE) is asynchronous or loss of frame
Resynchronisation	Resynchronisation of the U interfaces
Deactivate Indication	Deactivation is terminated
RDS Indication	Measurement at the NT: RDS is valid now
Activate Request	Measurement at the NT: request for activation without loop
Activate Indication	Measurement at the NT: activation without loop is terminated
RDS-Counter Overflow	RDS-counter has overflown
LOOP2 not closed => S0=off	Measurement at the NT: loop 2 is not closed because S0=OFF Loop 2 is only closed in the S0 module

Activate Request LOOP 1	Measurement at the NT: request for activation for loop 1
Act. Indication LOOP 1	Measurement at the NT: activation of loop 1 is terminated
Send Continuous Pulses	Continuous pulses are sent
Send Single Pulses	Single pulses are sent
Trace-Buffer full	The trace-buffer is full

#### Further results for

- BIT ERROR MEASUREMENT = ON

BER-U: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-U: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface
TIME: <time>	Time taken for calculating the bit error rate

- S0 = ON

BER-S0: <error rate>	Bit error rate of the bit error measurement at the S0 interface
BE-S0: <error sum>	Sum of the bit errors accrued in the bit error measurement at the S0 interface

- RDS-COUNTER

Running Digital Sum Counter	Is increased if a block error occurred in the transmission
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- PPM

The actual shift of the modulation rate in ppm is displayed.



**Error messages**

L3P: Switchb. error	Error in the setting of the measuring panel for functional tests
L3P: Setup error	Erro in the setting of the module Functional Tests (e.g. wrong setting parameters)
L3P: Eventkey error	A wrong key information for the event keys has been transferred by the HOST.
L3P: Act. failed	No activation within a timeout of 20 s, i.e. even the built-in layer 1 component of K1404 does not react. Try to activate once more!
L3P: deactivated	L331 is deactivated (this message appears in other types of measurement (e.g. Power Spectral Density) in case of L331 service.)
L3P: Error on U	Error at the U interface (this message appears in other types of measurement (e.g. Power Spectral Density) in case of L331 service.)
L3P: Data in error	Error in the data transfer from HOST to module
L3P: Data out error	Error in the data transfer from module to HOST
L3P: Host Command?	Wrong command output to module by HOST
L3P: S0 not active	S0 (TE) is not activated (this message is indicated at the NT in case of jitter measurement)
Timeout START again	The module has failed to report readiness to the HOST in time and is therefore reset. Start again!
Trace-Buffer full	Trace-buffer is full. Max. number of trace lines (400) was reached.

After a measurement has been terminated via STOP you can call up the **Result mode** via the RESULT key. You will then obtain the scroll keys TR <-- or TR --> which allow you to shift the trace lines backwards and forwards.

TR <--

Scroll backwards: trace lines are shifted in downward direction.

TR -->

Scroll forward: trace lines are shifted in upward direction..

Exit the result mode by repeatedly pressing the RESULT key.

### Measuring at the LT

Measuring at the LT differs in several points. The pages below therefore offer a complete description of the LT measurement.

					DATA CONT. B1 RX: INT. TX: INT.	
					BIT ERRORS OFF	
					PN PATTERN 211-1 ERRORS NO	START OF FREQU. 0 PPM
MEASUREMENT (LT) FREQUENCY SHIFTING	CONTROL ACT. DOWNSTRM.	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	LOAD OFF

Depending on the codes  $U_{2B1Q}$ ,  $U_{4B3T}$  or  $U_{P0}$  set in the SETUP menu, the different menus for the control are opened.

#### $U_{2B1Q}$ code

##### CONTROL

If you touch this panel, another menu will be opened in which you can select the available controls of layer 1:

ACT. DOWNSTRM.
ACT. UPSTREAM
ACT. LOOP 3
SINGLE PULSES

##### ACT. DOWNSTRM.

Activation downstream: K1404 (NT) is ready for an activation triggered by the device under test (LT)

##### ACT. UPSTREAM (ONLY FOR $S_0$ : off)

Activation upstream: K1404 (LT) has triggered an activation.

##### ACT. LOOP 3 (ONLY FOR $S_0$ : off)

Activation of the test loop 3: The loop is closed directly in the chip of the NT at the U interface. Thus, all channels (B1+B2+D) are looped back. Data from the LT is ignored. The loop signal is present in transparent form at the U sockets.

SINGLE PULSES (ONLY FOR  $S_0$ : off)  
The measuring device sends single pulses (SSP).

### $U_{4B3T}$ code

#### CONTROL

If you touch this panel, another menu will be opened in which you can select the available controls of layer 1:

ACT. DOWNSTRM.
ACT. UPSTREAM
ACT. LOOP 3
SINGLE PULSES

#### ACT. DOWNSTRM.

Activation downstream: K1404 (NT) is ready for an activation triggered by the device under test (LT)

#### ACT. UPSTREAM (ONLY FOR $S_0$ : off)

Activation upstream: K1404 (LT) has triggered an activation.

#### ACT. LOOP 3 (ONLY FOR $S_0$ : off)

Activation of the test loop 3: The loop is closed directly in the chip of the NT at the U interface. Thus, all channels (B1+B2+D) are looped back. Data from the LT is ignored. The loop signal is present in transparent form at the U sockets.

#### SINGLE PULSES (ONLY FOR $S_0$ : off)

The measuring device sends single pulses (SSP).

### $U_{p0}$ code

#### CONTROL

If you touch this panel, another menu will be opened in which you can select the available controls of layer 1:

ACT. DOWNSTRM.
ACT. UPSTREAM
ACT. LOOP 3
SINGLE PULSES
CONTINUOUS PULSES

## ACT. DOWNSTRM.

Activation downstream: K1404 (NT) is ready for an activation triggered by the device under test (LT)

ACT. UPSTREAM (ONLY FOR  $S_0$ : off)

Activation upstream: K1404 (LT) has triggered an activation.

ACT. LOOP 3 (ONLY FOR  $S_0$ : off)

Activation of the test loop 3: The loop is closed directly in the chip of the NT at the U interface. Thus, all channels (B1+B2+D) are looped back. Data from the LT is ignored. The loop signal is present in transparent form at the U sockets.

SINGLE PULSES (ONLY FOR  $S_0$ : off)

The measuring device sends single pulses (SSP).

CONTINUOUS PULSES (ONLY FOR  $S_0$ : off)

The measuring device sends continuous pulses (frequency: 192 kHz).

## TERMINATION

Adjustment of the Analyzer to the device under test: Selection 135  $\Omega$  / 150  $\Omega$  at  $U_{2B1Q}$  and  $U_{4B3T}$  interfaces. 100  $\Omega$  is preset for the  $U_{P0}$  interface.

## CONN. W. OBJ.

Connection with the device under test: Connection options between the internal U interface and the device under test are indicated. For  $U_{2B1Q}$  and  $U_P$  interface, a change of the setting after STOP is only accepted at START if there is also a deactivation. For  $U_{4B3T}$  the chosen setting is accepted without deactivation at START.

DIRECT
ATTENU- ATION
EXT. LINE
EXT.L: +PWR.

## DIRECT

The U interface is directly connected with the U sockets on the front panel.

ATTENUATION (NOT FOR  $U_{P0}$  INTERFACE)

Between the U interface and the U sockets a symmetrical  $\Pi$ -divider with 12 dB attenuation is looped through.

## EXT. LINE.

The connection between U interface and U sockets is interrupted by the socket pairs EXTERNAL LINE OUT and IN. When an artificial line is connected to these socket pairs, the U signal will be routed without DC voltage content via the artificial line. In this case the load for the feeding is present at the U sockets.

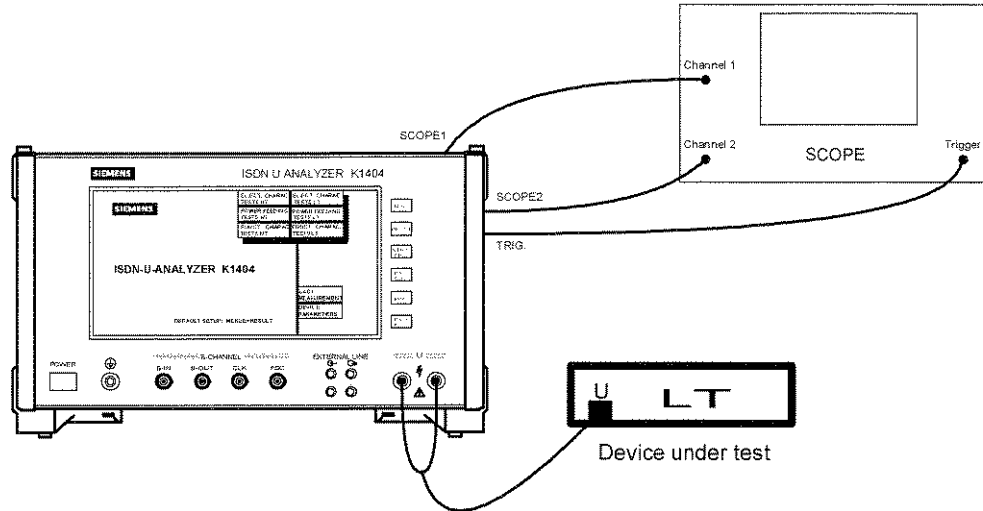
## EXT. L. +PWR.

External line and feeding voltage: One end of the artificial line is directly connected to the U sockets while the device under test (LT) is connected to the other end. The far end can be connected via the sockets EXTERNAL LINE IN: This allows you to observe the layer 1 signal at the device under test.

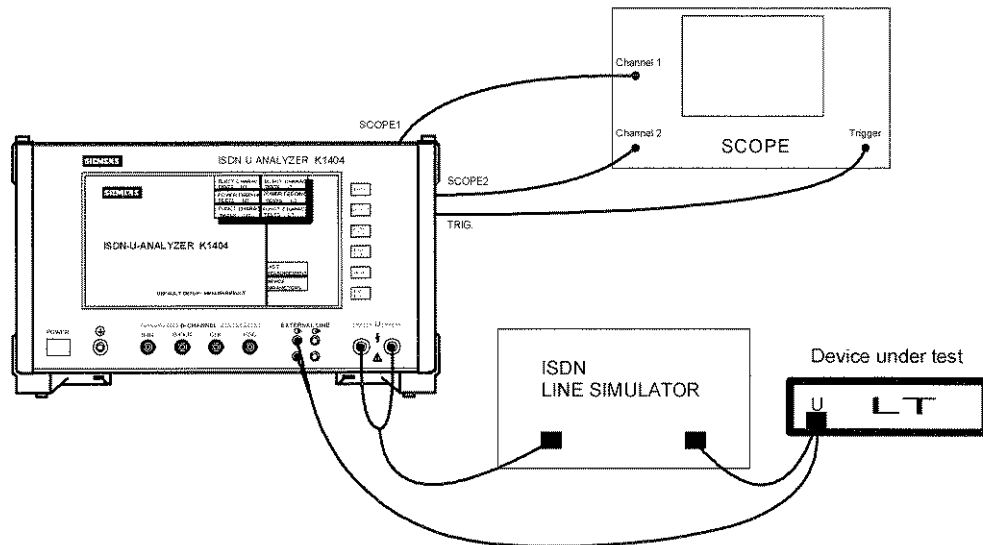
Built-in measuring heads with subsequent buffer and driver amplifiers allow simultaneous observation of the layer 1 setup and operation at the interface and at the device under test (LT). When an attenuator or an artificial line is inserted, the signals pertaining to the LT and NT can be unmistakably distinguished.

Socket SCOPE 1: signals from the LT side, socket SCOPE 2: signals from the NT side, 50 Ω / coaxial (device rear: module L31 slot 1). Trigger signal applied to socket TRIG. (device rear: module L330 slot 4 or 5).

Test set-up



Test set-up for EXT. L. + PWR. (external line and feeding voltage)



S<sub>0</sub>

The internal S<sub>0</sub> interface (modified S<sub>0</sub> interface without load from the measuring device) is switched on or off.

DATA CONT.

If the internal S<sub>0</sub> interface is switched off, the following data control menu is displayed for reading in and out the data on the U interface:

B1+B2 RX: INT TX: INT	B1 RX: INT TX: INT	B2 RX: INT TX: INT	MON+B* RX: EXT
B1+B2 RX: EXT TX: INT	B1 RX: EXT TX: INT	B2 RX: EXT TX: INT	MON RX: EXT
B1+B2 RX: INT TX: EXT	B1 RX: INT TX: EXT	B2 RX: INT TX: EXT	B* RX: EXT
B1+B2 RX: EXT TX: EXT	B1 RX: EXT TX: EXT	B2 RX: EXT TX: EXT	B1+B2 TRANS- PARENT
			ESC

B1 + B2

Bit error measurement in B1 and B2 (128 kBit/s)

B1

Bit error measurement in B1 only (64 kBit/s)

B2

Bit error measurement in B2 only (64 kBit/s)

RX INT

Data received at U is evaluated by the internal bit error counter.

RX EXT

Data received at U is available at socket B-OUT for external evaluation.

TX INT

Data output to U is created by the internal pattern generator.

TX EXT

Data output to U is read in via the socket B-IN.

MON

Monitor channel of the IOM interface (read only access, 64 kBit/s)

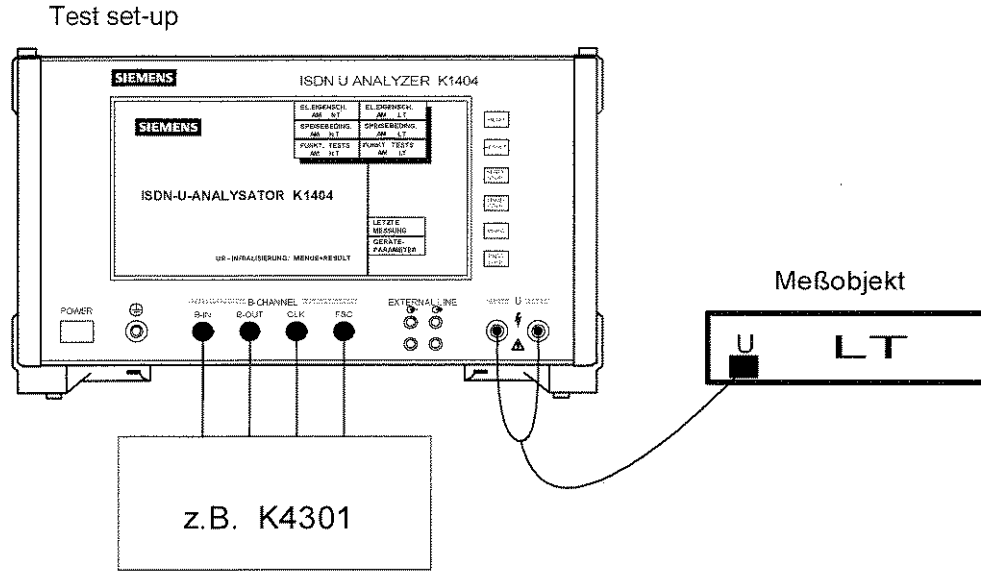
B\*

B\* channel of the IOM interface (read only access, 64kBit/s):

2 bits D channel, 4 bits command/indiction, 2 bits handshake for monitor channel

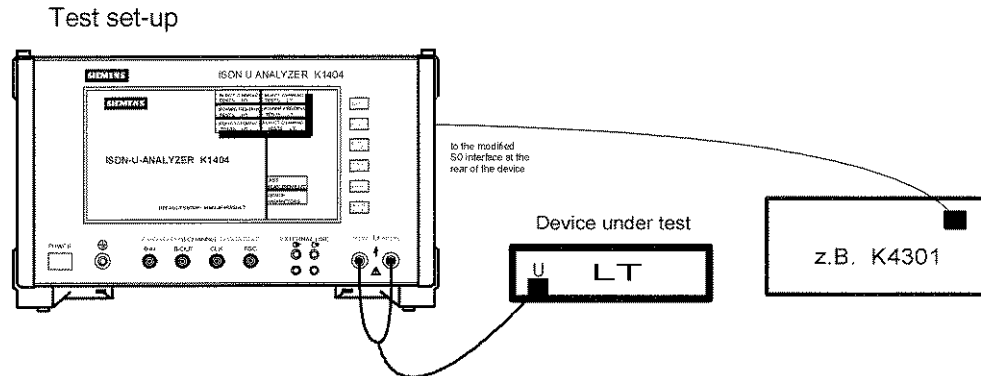
TRANSPARENT

Data is neither read into nor out of the B channels.



BIT ERROR MEASUREMENT

The bit error measurement is switched on or off. As long as the modified  $S_0$  interface is switched off, the data patterns are read into the U interface of the analyzer, or read out by it, and examined.



If the device-internal  $S_0$  interface is active, an internal bit error measurement is not possible.

For CONTINUOUS 0 and CONTINUOUS 1 no bit error measurement is implemented.

PN PATTERN / ERROR

The following menu is opened showing the bit patterns created by the pattern generator and the possible error rates:

PN PATTERN -->
ERRORS -->

PN PATTERN

The bit patterns  $2^{20}-1$ ,  $2^{16}-1$ ,  $2^{11}-1$ ,  $2^9-1$  of duration 0 and 1 that are created by the pattern generator can be inserted into the B channels. The selected bit pattern  $2^{20}-1$  to  $2^9-1$  only appears in the data channel if the bit error measurement is switched on. Only CONTINUOUS 0 and CONTINUOUS 1 are transmitted in the selected data channel with the bit error measurement switched off.

$2^{20}-1$	$2^9-1$
$2^{16}-1$	CONT. 0
$2^{11}-1$	CONT. 1

ERRORS

Errors with error rates of  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-6}$ ,  $10^{-7}$  can be inserted into the bit patterns created by the pattern generator.

NO	$10^{-5}$
$10^{-3}$	$10^{-6}$
$10^{-4}$	$10^{-7}$

TRIGGER

This function displays the trigger signals which are provided at the socket TRIG. (device rear) by the functional tests module.

NO
U-FRAME
U-CLOCK
CIC

NO

No trigger signal is output.



## U-FRAME

A negative pulse synchronous to the U super frame for  $U_{2B1Q}$  or synchronous to the U frame for  $U_{4B3T}$  and  $U_{P0}$  is output. Like that, an oscilloscope can be triggered externally. The U signals at the sockets SCOPE 1 and SCOPE 2 can be evaluated like that. The moment of triggering may be shifted after the start of the measurement by means of the two trigger keys TR <-- and TR -->. This makes for optimum presentation, e.g. when displaying the sync word of an U frame on the oscilloscope.

## U-CLOCK

The 80 kHz ( $U_{2B1Q}$ ), 120 kHz ( $U_{4B3T}$ ) or 384 kHz ( $U_{P0}$ ) clock is output in synchronization with the U interface.

## CIC

If you have not selected DEACT. + ACT from the menu panel CONTROL: Any status change of layer 1 is indicated by a level change. At the start of an activation the message "High" is output. If you have selected DEACT. + ACT from the menu panel CONTROL: During the trace line output the message "High" is given to indicate that within this time no control pulse must be applied since otherwise the time values for deactivation and activation would be incorrect. The message "Low" indicates that the device is once more ready for a control pulse.

## MOS (ONLY FOR 2B1Q INTERFACE)

Any monitor status change is indicated by a level change. This is the case if the message "EOC-Acknowledge" is returned, if a change in the overhead bits has occurred or if the near/far end block error counter can be read out. At the start of an activation the message "High" is output.

## CLOCK

If you touch this panel, a menu appears in which the master clock generation can be set. If the device is fitted with the jitter option module (L300), the additional panel JITTER appears.

INTERNAL
EXTERNAL 2.048MHz
EXTERNAL 1.536MHz
JITTER

## INTERNAL

Master clock generation with internal master oscillator.

## EXTERNAL 2.048MHZ

The internal master oscillator is synchronized via a 2.048 MHz signal.

## EXTERNAL 1.536MHZ

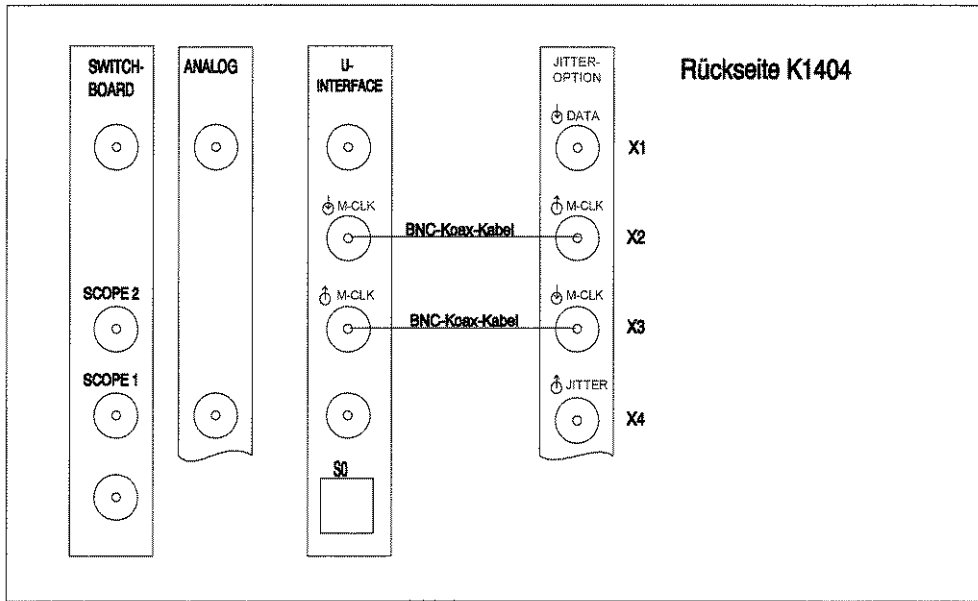
The internal master oscillator is synchronized via a 1.536 MHz signal. The external clock signal must be applied to the socket SYST. (device rear).

## JITTER

The IECQ in the K1404 is operated with an external clock signal (15.36 MHz).

The external clock signal must be applied at the M-CL. socket (rear of device).

Test set-up (rear)



For the test set-up and the settings for the bit error measurement, read the section *Frequency shifting* in the manual.

When you touch the panel JITTER, you receive the two additional panels: JITTER DEVIATION and JIT.FRQ..

					DATA CONT. B1	CLOCK
					RX:INT. TX:INT.	JITTER
					BIT ERRORS OFF	JITTER-AMPL. 0.024UI
					PN PATTERN 211-1	JIT.FRQ. [Hz] 200.0
					ERRORS NO	START OF FREQU. 0 PPM
MEASUREMENT (NT) FREQUENCY SHIFTING	CONTROL DEACTIVATION	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER OFF

JITTER AMPLITUDE

When you touch this panel, a numeric field is opened via which you can set the JITTER AMPLITUDE, corresponding to the JITTER FREQUENCY RANGE; from 0.002 UI to 0.400 UI in 0.002 UI steps (JITTER FREQUENCY RANGE: 0.1 Hz to 200 Hz) or from 0.001 UI to 0.020 UI in 0.001 UI steps (JITTER FREQUENCY RANGE: 200 Hz to 20 kHz).

JITTERAMPL. [UI]: [REDACTED] 0.002 «» 0.400				7	8	9	CLOCK
				4	5	6	JITTER
				1	2	3	JITTER-AMPL.
				0	.		.024UI
							JIT.FRQ. Hz
							00.0
							START OF FREQU. 0 PPM
MEASUREMENT (MT) FREQUENCY SHIFTING	CONTROL DEACTIVATION	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER OFF	

JIT.FRQ.

With this key 2 fields are offered in the menu for selecting the jitter frequency ranges.

JITTER-FREQUENCY RANGE 0.1-200 Hz
JITTER-FREQUENCY RANGE 0.2-20 kHz

JITTER FREQUENCY RANGE

When you have selected the JITTER FREQUENCY RANGE, a numeric field appears with which you can set the desired jitter frequency.

After selecting the jitter frequency in the range of 200 Hz to 20 kHz, a numeric field for entering the jitter deviation is opened automatically.

JITTERFREQU.[Hz]: [REDACTED] 0.1 «» 200.0				7	8	9	CLOCK
				4	5	6	BREAK
				1	2	3	JITTER- MPL.
				0	.		.024UI IT.FRG. [Hz] 00.0
				START OF FREQU. 0 PPM			
MEASUREMENT (NT) FREQUENCY SHIFTING	CONTROL DEACTIVATION	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER OFF	

START FREQUENCY

The shift of the master frequency (15.36 MHz) can be changed in steps of 1 ppm from + 127 to -128. The following editing panel is opened:

Frqu.Shift [ppm]: -125 -128 «» +127				7	8	9	CLR
				4	5	6	BREAK
				1	2	3	RUB
				0		+/-	ENTER
				START OF FREQU. 0 PPM			
MEASUREMENT (LT) FREQUENCY SHIFTING	CONTROL ACT.DOWNSTRM.	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	LOAD OFF	

The master frequency can also be changed during a measurement by using the arrow keys f <-- and f -->.

LOAD

This panel opens another menu in which you can select from the following settings:

OFF
EXTERNAL
NORMAL

OFF

The load is switched off.

EXTERNAL

Load can be supplied externally via sockets U1 and U2 at the rear of the device (feeding, slot 7).

NORMAL

An editing menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA.

**Measurement (LT)**

Start the measurement via the START/STOP key. The following window appears with the additional event functions:

					DATA CONT. B1 RX:INT. TX:INT.	
					BIT ERRORS OFF	
					PN PATTERN 2 <sup>11</sup> -1 ERRORS NO	START OF FREQU. 0 ppm
MEASUREMENT (LT) FREQUENCY SHIFTING	CONTROL ACT.DOWNSTRM.	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	LOAD OFF

DELETE BIT ERROR

The displayed bit errors are deleted, the bit error timer is reset.

SINGLE BIT ERROR

A single bit error is inserted into the internally generated bit pattern.

TR <--

The triggering moment of the U FRAME trigger signal is shifted. The display on the oscilloscope is shifted to the left until the TR <-- or TR --> key is pressed again.

TR -->

The triggering moment of the U FRAME trigger signal is shifted. The display on the oscilloscope is shifted to the right until the TR <-- or TR --> key is pressed again.

f <--

In intervals of three seconds the master frequency is decreased in steps of 1 ppm starting with the value which was set in the menu point START FREQUENCY. This process continues until the minimum value of -128 ppm has been reached or until either the f <-- or f --> key is pressed again

f -->

In intervals of three seconds the master frequency is increased in steps of 1 ppm starting with the value which was set in the menu point START FREQUENCY. This process continues until the maximum value of +127 ppm has been reached or until either the f <-- or f --> key is pressed again.



In case of jittered measuring operation you must stop the measurement before entering the jitter frequency or the jitter shift.

**Result structure (LT)**

All functional tests are displayed in trace lines.

**2B1Q interface**

LT: Funct. Charac. Frequency Shifting 2B1Q					DATA CONT. B1	
001 deactivated 000.0 us 000.0 us					RX:INT.	
002 T2: Waiting for SL2 02.86 s 02.86 s					TX:INT.	
003 T6: Superframe acquired 03.45 s 594.1 ms					BIT ERRORS	
004 EDC-Req: R.to Norm. Adr: 0 05.52 s 02.07 s					OFF	
005 Overh. B: 011 111 111 111 05.53 s 001.2 ms					PN PATTERN	
006 EDC-Req: L-2 B1 Adr: 0 23.84 s 18.31 s					211-1	
NEBE-counter: 00000 Overhead Bits:					ERRORS	START OF
FEBE-counter: 00000 act :0 usr1:1 usr2:1					NO	FREQU.
PPM : 0 dea :1 usr3:1 febe:1						0 ppm
usr4:1 usr5:1 usr6:1						
usr7:1 uoa :1 aib :1						
MEASUREMENT (LT)	CONTROL ACT.DOWNSTRM.	TERMI- NATION	CONT. TO IUT	50	TRIGGER	LOAD
FREQUENCY SHIFTING		135 Ω	DIRECT	OFF	U-FRAME	OFF
<b>SIEMENS ISDN U-Analyzer K1404</b>					TIFF-Hardcopy Tool V3.00 (c) SIEMENS AG	

The trace lines have the following format:

NNN TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT ZZZZZ EEE ZZZZZ EEE

N

Line number, 3 digits: NNN: 001 to 400. Up to 400 trace lines can be recorded. Once a measurement has been terminated via STOP these trace lines may be viewed in the RESULT mode window by scrolling.

T

Trace line text, up to 28 characters. For reasons of space an overview of the trace line texts is given further below.

Z

Time values, 5 digits. The first time value is the time which has elapsed since the start of an activation.

E

Unit of time, max. 3 digits. The second time value is the time difference relative to the preceding event.

The trace lines are displayed in the following format:

- xxx.x us microseconds
- xxx.x ms milliseconds
- xx.xx s seconds
- xx:xx min minutes
- xx:xx h hours

Maximum total time: 18:12 h.

The following table offers an overview of the **trace line texts** of the 2B1Q interface and their description:

Power Up	Layer 1 is awake
T2: Waiting for SL2	ANSI timestep T2: NT expects SL2 signal
T6: Superframe acquired	ANSI timestep T6: NT has received superframe marker
T7: Full Op. (act=0)	ANSI timestep T7: Layer 1 is activated, Activation bit = 0
T7: Full Op. (act=1)	ANSI timestep T7: Layer 1 is activated, Activation bit = 1, layer 2 could be activated
EOC-Com: L-2 2B+D Adr: a	EOC command: Close LOOP 2 with 2B + D (close complete loop back 2), EOC address a (a = 0 ... 7)
EOC-Com: L-2 B1 Adr: a	EOC command: Close LOOP 2 with B1 (close partial loop back 2), EOC address a (a = 0 ... 7)
EOC-Com: L-2 B2 Adr: a	EOC command: Close LOOP 2 with B2 (close partial loop back 2), EOC address a (a = 0 ... 7)
EOC-Com: Req. CCRC Adr: a	EOC command: Request of corrupted CRC. The LT requests transmission of corrupted CRC. EOC address a (a = 0 ... 7)
EOC-Com: Not. CCRC Adr: a	EOC command: Notify of corrupted CRC. The LT notifies that corrupted CRC are transmitted EOC address a (a = 0 ... 7)
EOC-Com: R.to Norm. Adr: a	EOC command: Return to normal. All previous EOC commands are cleared. EOC address a (a = 0 ... 7)
EOC-Ack:   aaa d iiii iiii	An EOC acknowledgement not defined in ANSI or ETSI has been received: aaa:   3 bits EOC address 0 to 7 binary; d:     1 bit data / message indicator; iiii iiii: 8 bits information
Loop 2 2B+D closed in IEC-Q	Complete loop back 2 has been closed in the IEC-Q (while S <sub>0</sub> = OFF)
Loop 2 2B+D closed	Complete loop back 2 has been closed in the component S <sub>0</sub> (SBC or ISAC-S) (while S <sub>0</sub> = ON)
Loop 2 B1 closed	Partial loop back 2 has been closed in the IEC-Q (Partial loop back 2 is always closed in the IEC-Q)
Loop 2 B2 closed	Partial loop back 2 has been closed in the IEC-Q (Partial loop back 2 is always closed in the IEC-Q)
Loop 3 closed	LOOP 3 in NT is closed
Send Single Pulses	K1404 sends single pulses
Error on U	Error on U interface
Far-End-Counter Overflow	Overflow of far-end block error counter
Near-End-Counter Overflow	Overflow of near-end block error counter
Loss Of Synchronisation	Loss of synchronisation on U



Loss Of Signal	No more signal present on U
BE-U: AIS	Bit error measurement at U: Alarm indication signal. Receipt of duration '1'
BE-U: Continuous Zero	Bit error measurement at U: Continuous zero. Receipt of duration '0'
BE-U: Bit slip	Bit error measurement at U: Bit slip. Bit error measurement is asynchronous
BE-U: run	Bit error measurement at U is running
Trace-Buffer full	Trace buffer is full. Max. number of trace lines (400) has been reached.
Overh. B: xxx xxx xxx xxx	All overhead bits are displayed at the positions M4, M5 and M6 (without CRC!) in the order of their transmission in the super frame. Presentation in ternary groups corresponds to the display of overhead bits in the lower display area.

## Further results for

## - BIT ERROR MEASUREMENT = ON

BER-U: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-U: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface
TIME: <time>	Time taken for calculating the bit error rate

## - NB-COUNTER

Near-end block error counter	Incremented if a block error has occurred in the transmission from the device under test to K1404.
Near-end-block error	The CRC calculated in K1404 does not correspond to the CRC as received.

## - FB-COUNTER

Far-end block error counter	Incremented if a block error has occurred in the transmission from the device under test to K1404.
Far-end block error	The CRC calculated in K1404 does not correspond to the CRC as received. In the subsequent super frame the device under test will set the far-end block error bit (febe) to '0' with the result that the far-end block error counter is raised in K1404.

## - PPM

The actual shift of the master frequency compared to the nominal value 15.36 MHz is displayed in ppm.

### - Overhead Bits

The overhead bits are displayed in the order in which they are received at the U interface. The four lines containing 3 bits each correspond to a ternary group in the trace line presentation of the overhead bits, i.e. when measurements are performed at the NT:

1st Ternary group:	act	usr1	usr2
2nd Ternary group:	dea	usr3	febe
3rd Ternary group:	usr4	usr5	usr6
4th Ternary group:	usr7	uoa	aib

#### 1st group

act      Activation bit (=1, if ready for layer 2 activation)  
 usr1     User bit 1 (reserved for future applications)  
 usr2     User bit 2 (reserved for future applications)

#### 2nd group

dea      Deactivation Bit 1 (=0, if a deactivation is signalled.  
           dea = 0 must be fulfilled for at least three super frames before the  
           LT stops the transmission)  
 usr3     User bit 3 (reserved for future applications)  
 febe     Far-end block error bit (=0, if a block error has occurred in the di-  
           rection of receipt. This means that at the remote terminal the far-  
           end block error counter is raised)

#### 3rd group

usr4     User Bit 4 (reserved for future applications)  
 usr5     User Bit 5 (reserved for future applications)  
 usr6     User Bit 6 (reserved for future applications)

#### 4th group

usr7     User bit 7 (reserved for future applications)  
 uoa      U only Activation (=0, if only the U side of a NT is to be activated.  
           The use is optional, if it is not used always uoa = 1)  
 aib      Alarm Indicator Bit (= 0, if error or interruption in the transmission of  
           the D channel or both B channels, e.g. loss of signal, loss of sync.  
           The use is optional, if it is not used always aib = 1)

**Error messages**

L3Q: Switchb. error	Error in the setting of the measuring panel for functional test
L3Q: Setup error	Error in the setting of the module Functional Tests (e.g. wrong setting parameter)
L3Q: Handsh. T-out	Timeout for result output to HOST has occurred. No results are output. However, no results are lost as they are accounted for at the next output.
L3Q: Status error	Error in the status output to the HOST.
L3Q: Eventkey error	A wrong key information for the event keys has been transferred by the HOST.
L3Q: Act. failed	No activation within a timeout of 20 s, i.e. even the built-in layer 1 component of K1404 does not react. Try to activate once more!
L3Q: No MON-Command	Due to an internal error no monitor command could be transmitted, i.e. no EOC commands were output nor were block error counters read out. Deactivate and activate once more! In case of repeated occurrence of this error switch the device off and on.
L3Q: Data in error	Error in the data transfer from HOST to module
L3Q: Data out error	Error in the data transfer from module to HOST
L3Q: Host Com. error	Wrong command output to module by HOST
L3Q: NO RESP	Module Functional Tests does no longer react. Switch the device off and on again.!
Timeout START again	The module has failed to report readiness to the HOST in time and is therefore reset. Start again!

After a measurement has been terminated via STOP, you can call up the **Result mode** via the RESULT key. You will then obtain the scroll keys TR <-- or TR --> which allow you to shift the trace lines backwards and forwards.

TR <--

Scroll backwards: trace lines are shifted in downward direction.

TR -->

Scroll forward: trace lines are shifted in upward direction..

Exit the result mode by repeatedly pressing the RESULT key.

**Result structure (LT)**

All functional tests are displayed in trace lines.

**4B3T interface**

LT: Funct. Charac. Frequency Shifting 4B3T					DATA CONT.	
001	Power up		000.0 us	000.0 us	B1	
002	SIG 1A: Resync. downstream		08.92 s	08.92 s	RX: INT.	
003	SIG 2W: Line awake (L. #2)		09.12 s	203.6 ms	TX: INT.	
004	SIG 5: Line act. (L. #2)		09.16 s	030.5 ms	BIT ERRORS	
005	Loop #2 closed in IEC-T		09.16 s	000.0 ms	OFF	
RDS-counter : 00003					PN PATTERN	START OF
PPM : 0					2 <sup>11</sup> -1	FREQU.
					ERRORS	0 PPM
					NO	
MEASUREMENT (LT) FREQUENCY SHIFTING	CONTROL ACT.DOWNSTRM.	TERMI- NATION 150 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	LOAD OFF
<b>SIEMENS ISDN U-Analyzer K1404</b>					TIFF-Hardcopy Tool V3.00 (c) SIEMENS AG	

The trace lines have the following format:

NNN TTT ZZZZZ EEE ZZZZZ EEE  
N

Line number, 3 digits: NNN: 001 to 400. Up to 400 trace lines can be recorded. Once a measurement has been terminated via STOP these trace lines may be viewed in the RESULT mode window by scrolling.

T

Trace line text, up to 28 characters. For reasons of space an overview of the trace line texts is given further below.

Z

Time values, 5 digits. The first time value is the time which has elapsed since the start of an activation.

E

Unit of time, max. 3 digits. The second time value is the time difference relative to the preceding event.

The trace lines are displayed in the following format:

- xxx.x us      microseconds
- xxx.x ms      milliseconds
- xx.xx s       seconds
- xx:xx min     minutes
- xx:xx h       hours

Maximum total time: 18:12 h.

The following table offers an overview of the **trace line texts** of the 4B3T interface and their description:

Power up	The U module in the K1404 (NT) is powered up
SIG 0: Deact. Request	Request for deactivation
SIG 0: deactivated	The line is deactivated
SIG 2W: Line awake	K1404 (NT) has received U signal 2W
SIG 2: Sync. downstream	K1404 (NT) has received U signal 2
SIG 2W: Line awake (L. #2)	K1404 (NT) has received U signal 2W (request for loop 2)
SIG 2W: Line awake (L. #3)	K1404 (NT) has received U signal 2W (request for loop 3)
SIG 1A: Resync. downstream	K1404 (NT) sends U signal 1A (NT has received prompt signal (2W), line is asynchronous yet, or NT has lost synchronisation in active state)
SIG 5: Line active	K1404 (NT) sends U signal 5 (activation terminated)
SIG 5: Line act. (L. #2)	K1404 (NT) sends U signal 5 (activation with loop 2 terminated)
RDS-Counter Overflow	Runnig digital sum counter has overflown
Loop #2 closed in IEC-T	In the K1404 (NT) the requested loop 2 in the U module IEC-T is closed because S0=OFF
Activation Loop #3	K1404 (NT): activation of the local loop 3 is terminated
Send Single Pulses	K1404 sends single pulses

## Further results for

- BIT ERROR MEASUREMENT = ON

BER-U: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-U: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface
TIME: <time>	Time taken for calculating the bit error rate

- RDS-COUNTER

Running Digital Sum Counter	Is increased if a block error occurred in the transmission.
-----------------------------	---

- PPM

The actual shift of the master frequency compared to the nominal value 15.36 MHz is displayed in ppm.

**Error messages**

L3T: Switchb. error	Error in the setting of the measuring panel for functional test
L3T: Setup error	Error in the setting of the module Functional Tests (e.g. wrong setting parameter)
L3T: Handsh. T-out	Timeout for result output to HOST has occurred. No results are output. However, no results are lost as they are accounted for at the next output.
L3T: Status error	Error in the status output to the HOST.
L3T: Eventkey error	A wrong key information for the event keys has been transferred by the HOST.
L3T: Act. failed	No activation within a timeout of 20 s, i.e. even the built-in layer 1 component of K1404 does not react. Try to activate once more!
L3T: No MON-Command	Due to an internal error no monitor command could be transmitted, i.e. no EOC commands were output nor were block error counters read out. Deactivate and activate once more! In case of repeated occurrence of this error switch the device off and on.
L3T: Data in error	Error in the data transfer from HOST to module
L3T: Data out error	Error in the data transfer from module to HOST
L3T: Host Com. error	Wrong command output to module by HOST
L3T: L331 HW: 1.0	Measurement of the clock accuracy with single pulses is not possible with HW 1.0
L3T: NO RESP	Module Functional Tests does no longer react. Switch the device off and on again!
Timeout START again	The module has failed to report readiness to the HOST in time and is therefore reset. Start again!

After a measurement has been terminated via STOP, you can call up the **Result mode** via the RESULT key. You will then obtain the scroll keys TR <-- or TR --> which allow you to shift the trace lines backwards and forwards.

TR <--

Scroll backwards: trace lines are shifted in downward direction.

TR -->

Scroll forward: trace lines are shifted in upward direction..

Exit the result mode by repeatedly pressing the RESULT key.



**Result structure (LT)**

All functional tests are displayed in trace lines.

**U<sub>PG</sub> interface**

LT: Funct. Charac. Frequency Shifting UP0					DATA CONT. B1	
001 deactivated 000.0 us 000.0 us					RX: INT.	
002 Power Up 209.0 ms 209.0 ms					TX: INT.	
003 Resynchronisation 211.7 ms 002.7 ms					BIT ERRORS	
004 Activate Request No LOOP 231.3 ms 019.6 ms					OFF	
005 Act. Indication No LOOP 251.5 ms 020.1 ms						
RDS-counter : 00000					PN PATTERN 211-1	START OF FREQU.
PPM : 0					ERRORS NO	0 PPM
MEASUREMENT (LT) FREQUENCY SHIFTING	CONTROL ACT.UPSTREAM	TERMI- NATION 100 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	LOAD OFF
<b>SIEMENS ISDN U-Analyzer K1404</b>					TIFF-Hardcopy Tool V3.00 (c) SIEMENS AG	

The trace lines have the following format:

NNN TTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTTT ZZZZZ EEE ZZZZZ EEE

N

Line number, 3 digits: NNN: 001 to 400. Up to 400 trace lines can be recorded. Once a measurement has been terminated via STOP these trace lines may be viewed in the RESULT mode window by scrolling.

T

Trace line text, up to 28 characters. For reasons of space an overview of the trace line texts is given further below.

Z

Time values, 5 digits. The first time value is the time which has elapsed since the start of an activation.

E

Unit of time, max. 3 digits. The second time value is the time difference relative to the preceding event.

The trace lines are displayed in the following format:

- xxx.x us      microseconds
- xxx.x ms     milliseconds
- xx.xx s      seconds
- xx:xx min    minutes
- xx:xx h      hours

Maximum total time: 18:12 h.

The following table offers an overview of the **trace line texts** of the U<sub>P0</sub> interface and their description:

Power Up	Measurement at the LT: IOM clocks are switched on
Deactivate Request	Request for deactivation
Deactivate Indication	Deactivation is terminated
deactivated	The line is deactivated
Timeout Act/Deact	Software timeout at the start of the activation or deactivation has occurred. Activation or deactivation has failed
LOOP #1 closed	Measurement at the NT: loop L1 is closed
Resynchronisation	Resynchronisation of the U interfaces
Activate Request No LOOP	Measurement at the LT: request for activation without loop
Act. Indication No LOOP	Measurement at the LT: activation without loop is terminated
Activate Request LOOP 2	Measurement at the LT: request for activation with request to close loop 2
Act. Indication LOOP 2	Measurement at the LT: activation with loop 2 is terminated
BE-U: AIS	Bit error measurement at U: Alarme Indication Signal, receiving duration '1'
BE-U: Continuous Zero	Bit error measurement at U: receiving duration '0'
BE-U: Bitflip	Bit error measurement at U: bitflip. Receiver is asynchronous
BE-U: run	Bit error measurement at U: bit error measurement is running
BE-U: asynchron	Bit error measurement at U: receiver is asynchronous BER > 0.3
RDS-Counter Overflow	RDS-counter has overflown
Send Continuous Pulses	Continuous pulses are sent
Send Single Pulses	Single pulses are sent
Trace-Buffer full	The trace-buffer is full

## Further results for

## - BIT ERROR MEASUREMENT = ON

BER-U: <error rate>	Bit error rate of the bit error measurement at the U interface
BE-U: <error sum>	Sum of the bit errors accrued in the bit error measurement at the U interface
TIME: <time>	Time taken for calculating the bit error rate

## - RDS-COUNTER

Running Digital Sum Counter	Is increased if a code error occurred in the transmission.
-----------------------------	--

## - PPM

The actual shift of the master frequency compared to the nominal value 15.36 MHz is displayed in ppm.

**Error messages**

L3P: Switchb. error	Error in the setting of the measuring panel for functional test
L3P: Setup error	Error in the setting of the module Functional Tests (e.g. wrong setting parameter)
L3P: Eventkey error	A wrong key information for the event keys has been transferred by the HOST.
L3P: Act. failed	No activation within a timeout of 20 s, i.e. even the built-in layer 1 component of K1404 does not react. Try to activate once more!
L3P: Data in error	Error in the data transfer from HOST to module
L3P: Data out error	Error in the data transfer from module to HOST
L3P: Host Command?	Wrong command output to module by HOST
Timeout START again	The module has failed to report readiness to the HOST in time and is therefore reset. Start again!

After a measurement has been terminated via STOP, you can call up the **Result mode** via the RESULT key. You will then obtain the scroll keys TR <-- or TR --> which allow you to shift the trace lines backwards and forwards.

TR <--

Scroll backwards: trace lines are shifted in downward direction.

TR -->

Scroll forward: trace lines are shifted in upward direction..

Exit the result mode by repeatedly pressing the RESULT key.

## 7.2 Short time interruption

If you touch the panel FUNCTIONAL TESTS in the basic menu the working menu appears for the functional tests. The option MEASUREMENTS: FREQUENCY SHIFTING is preset.

If you touch the panel MEASUREMENTS: FREQUENCY SHIFTING a selection window appears in which you may select the measurement SHORT TIME INTERRUPTION. You will obtain the following working menu:

					DATA CONT. B1 RX:INT. TX:INT.	CLOCK INTERNAL
					BIT ERRORS OFF	
					PN PATTERN 2 <sup>11</sup> -1 ERRORS NO	INTER- RUPT TIME 20 ms
MEASUREMENT (CNT) SHORT TIME INTERRUPTION	CONTROL DEACTIVATION	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER NORMAL 32.0 U



Except for the panel INTERRUPT. TIME, the operating menu for this mode of measurement is identical to the menu of the measurement FREQUENCY SHIFTING (see above).

INTERRUPT. TIME

Interruption time: The connection close to the U sockets is interrupted five times. The duration of each interruption can be set to values from 10 ms to 255 ms. If you touch this panel, the following editing window appears for your settings:

Interrupt Time[ms] <b>20</b> 20 «» 250		7	8	9	CLR	CLOCK
		4	5	6	BREAK	INTERNAL
		1	2	3	RUB	
		0			ENTER	
						INTER- RUPT TIME 20 ms
MEASUREMENT (NT) SHORT TIME INTERRUPTION	CONTROL DEACTIVATION	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER NORMAL 32.0 U

## Measurement

Start the measurement via the START/STOP key. The following window appears with the additional event functions:

NT: Funct. Charac. Short Time Interruption					DATA CONT. B1 RX: INT. TX: INT.	CLOCK INTERNAL
					BIT ERRORS OFF	
					PN PATTERN 2 <sup>11</sup> -1 ERRORS NO	
					BIT-ERROR	
					Tr <--	Tr -->
MEASUREMENT <NT> SHORT TIME INTERRUPTION	CONTROL DEACTIVATION	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME	POWER NORMAL 32.0 U

### DELETE BIT ERROR

The displayed bit errors are deleted, the bit error timer is reset.

### SINGLE BIT ERROR

A single bit error is inserted into the bit pattern generated internally.

### TR <--

The triggering moment of the U FRAME trigger signal is shifted. The display on the oscilloscope is shifted to the left until the TR <-- or TR --> key is pressed again.

### TR -->

The triggering moment of the U FRAME trigger signal is shifted. The display on the oscilloscope is shifted to the right until the TR <-- or TR --> key is pressed again.

### INTERRUPTION

The interruption sequence is triggered.

### Measuring at the LT

Measuring at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel POWER which applies to NT measurements is changed to the panel LOAD as for LT measurements.

		OFF		DATA CONT. B1 RX: INT. TX: INT.	
		EXTERNAL		BIT ERRORS OFF	
		NORMAL		PN PATTERN 2 <sup>11</sup> -1 ERRORS NO	
				INTER- RUPT TIME 20 ms	
MEASUREMENT (LT) SHORT TIME INTERRUPTION	CONTROL ACT. DOWNSTRM.	TERMI- NATION 135 Ω	CONT. TO IUT DIRECT	S0 OFF	TRIGGER U-FRAME U-CLOCK
					LOAD OFF

### LOAD

With regard to load the following settings may be selected:

#### OFF

The load is switched off.

#### EXTERNAL

Load can be supplied externally via sockets U1 and U2 at the rear of the device (feeding, slot 7).

#### NORMAL

An editing menu is opened which in addition to the preset load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA.



### 7.3 Clock accuracy

If you touch the panel **FUNCTIONAL TESTS** in the basic menu the working menu appears for the functional tests. The option **MEASUREMENTS: FREQUENCY SHIFTING** is preset.

If you touch the panel **MEASUREMENTS** a selection window appears in which you may select the measurement **CLOCK ACCURACY**. You will obtain the following working menu:

				CLOCK <b>INTERNAL</b>	
MEASUREMENT (NT) CLOCK ACCURACY	TRANSMIT OFF	TERMI- NATION 135 Ω		TRIGGER NO	POWER OFF

#### TRANSMISSION CLOCK

If you touch this panel, you will obtain a menu in which the transmission clock can be set.

OFF
DUT WITH SINGLE PULSES
DUT WITH U-SIGNAL
INSERTION LOSS

DUT WITH SINGLE PULSES (MEASUREMENT ONLY POSSIBLE AS OF L330 HW 1.0)

When the device under test sends single pulses, the analyzer K1404 determines the clock accuracy.

#### DUT WITH U SIGNAL

It is possible to determine the clock accuracy by means of an oscilloscope. For that, the U signal is observed via the socket **SCOPE1**. The oscilloscope is triggered via the socket **TRIG** to L33x with **U FRAMES**. Using the **f** keys after the start of the measurement allows you to change the trigger frequency (socket **TRIG**) in steps of 1 ppm so that the transmitted signal (e.g. the barker code) comes to a standstill. The deviation from the ideal frequency is indicated in ppm.

#### INSERTION LOSS

NTs which have been designed for the American standard can be deliberately activated by means of direct voltage pulses (NT Maintenance Modes). This allows

for an indirect measurement of the clock accuracy as under DUT WITH U SIGNAL.

TERMINATION

Adjustment of the analyzer to the device under test: 135 Ω / 150 Ω at 2B1Q- and 4B3T-Interface. For the Up-Interface 100 Ω is presetted.

TRIGGER

This function displays the trigger signals which are provided at the socket TRIG. (device rear) by the functional tests module.

NO
U-FRAME
U-CLOCK

NO

No trigger signal is output.

U-FRAME

A negative pulse synchronous to the U superframe is output. This pulse can be used to trigger an oscilloscope externally. The U signals at the sockets SCOPE 1 and SCOPE 2 can be evaluated like that. The moment of triggering may be shifted after the start of the measurement by means of the two trigger keys TR <-- and TR -->. This makes for optimum presentation, e.g. when displaying the sync word of an U frame on the oscilloscope.

U-CLOCK

The 80 kHz (2B1Q), 170 kHz (4B3T) and 364 kHz (Up) clock is output synchronously with the U interface.

CLOCK

(without function)

POWER

This panel opens another menu in which you can select from the following settings:

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

OFF

The feeding voltage is switched off.

EXTERNAL

The feeding voltage can be routed via sockets U1 and U2 at the rear of the device (feeding, slot 7).

**NORMAL**

The feeding voltage is applied without additional series resistor.

**NORMAL WITH RL**

The additional series resistor of 600  $\Omega$  simulates a line resistor.

The panels **NORMAL** or **NORMAL WITH RL** open the following editing menu:

EDIT
LAST EDIT VALUE
10 V
32 V
66 V
115 V

**EDIT**

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via **EDIT**).

The selected feeding voltage will be applied to the U socket after the **START** key has been activated.

**Measurement**

Start the measurement via the START/STOP key. You will then obtain the following window with the additional event functions:

NT: Funct. Charac. Clock Accuracy				CLOCK INTERNAL	
				f <-- / f -->	
				MEASUREMENT (NT) CLOCK ACCURACY	
		TERMI-NATION 135 Ω		TRIGGER NO	
				POWER OFF	

f <-- / f -->

The trigger frequency (socket TRIG) may be changed in steps of 1 ppm so that the transmitted signal (e.g. the barker code) comes to a standstill. The deviation from the ideal frequency is indicated in ppm.

**Measuring at the LT**

Measuring at the LT is only slightly different from measuring at the NT. Whereas in the case of NT measurement the device under test is only fed when required (e.g. in accordance with national standards), it is necessary to load the device under test in the case of an LT measurement. This is the only difference with regard to the device settings: The panel POWER which applies to NT measurements is changed to the panel LOAD as for LT measurements.

			OFF		
			EXTERNAL		
			NORMAL		
				CLOCK	INTERNAL
MEASUREMENT <LT>	TRANSMIT	TERMI- NATION		TRIGGER	LOAD
CLOCK ACCURACY	OFF	135 Ω		NO	OFF

**LOAD**

With regard to load the following settings may be selected:

**OFF**

The load is switched off.

**EXTERNAL**

Load can be supplied externally via sockets U1 and U2 at the rear of the device (feeding, slot 7).

**NORMAL**

An editing menu is opened which in addition to the pre-set load currents of 15 mA, 30 mA and 45 mA allows you to set the desired load current between 0 and 100 mA.



## 8 Jitter measurement

If you touch the panel `Jitter Measurement` in the basic menu, a working menu appears for the measurement and creation of phase jitter.

		ANALYSIS- RANGE 2Hz-20kHz	FILTER Fu/Fo 80 Hz 20 kHz
		RANGE 0-0.05 UI	
			MEAS.- SIGNAL- SOURCE 80 KHz
MEASUREMENT (NT) JITTER- MEASUREMENT		JITTER- GENERATOR OFF	POWER OFF



The jitter measurement option is available for the NT only. The jitter measurement is optional and can only be carried out if the corresponding module is plugged in.

First, adjust the feeding voltage to the device under test via the panel **POWER**.

OFF
EXTERNAL
NORMAL
NORMAL WITH RL

#### POWER

This panel opens another menu in which the following settings can be selected:

##### OFF

The feeding voltage is switched off.

##### EXTERNAL

The feeding voltage can be routed via sockets  $U_1$  and  $U_2$  at the rear of the device (feeding, slot 7).

##### NORMAL

The feeding voltage is applied without additional series resistor.

##### NORMAL WITH RL

The additional series resistor simulates a line resistor in the feeding path.

The panels **NORMAL** or **NORMAL WITH RL** open an editing menu.

##### EDIT

Apart from the preset voltages 10 V, 32 V, 66 V and 115 V any desired voltage value between 10 V and 120 V may be set in an editing panel (to be called up via **EDIT**).

The selected feeding voltage will be applied to the U socket after the **START** key has been activated.

Other device settings will depend on your particular measurement tasks:

#### ANALYSIS RANGE

For analysis of the power spectrum density you can choose between two frequency ranges: 2 Hz - 20 kHz is preset. The frequency range 10 Hz to 200 Hz is especially intended for analysis of system disturbances.

#### RANGE

Phase jitter measuring ranges: The following phase jitter measuring ranges can be set:

0 - 0.05 UI and 0 - 0.1 UI.



## Filter fu/fo

This panel opens another menu in which you can select the following settings:

<1 Hz	50 Hz
5 HZ	80 Hz
10 Hz	110 Hz
15 Hz	
30 Hz	next

High pass filters <1 Hz, 5 Hz, 10 Hz, 15 Hz, 30 Hz, 50 Hz, 80 Hz and 110 Hz can be selected (reference: 3 dB limit frequency). Attenuation of the high passes is 20 dB/decade.

You can either select a new frequency limit or confirm the preset high pass via NEXT. Another menu will be opened:

	3 kHz
270 HZ	10 kHz
350 Hz	20 kHz
600 Hz	40 kHz
1 kHz	next

Low pass filters 270 Hz, 350 Hz, 600 Hz, 1 kHz, 3 kHz, 10 kHz, 20 kHz and 40 kHz can be selected (reference: 3 dB limit frequency). Attenuation of the low pass filters is 20 dB/decade.

You can either select a new frequency limit or confirm the preset low pass via NEXT.

## MEASURING SIGNAL SOURCE

Various measuring signal sources of the device under test are available for jitter measurement:

S0
U
80 kHz
120 kHz
256 kHz
512 kHz

## S0

The phase jitter is measured at the S0 interface of the device under test (NT).

## U

The phase jitter is measured at the U interface of the device under test (NT) by means of a measuring extension (jitter box).

## 80 KHZ

The phase jitter is measured at a 80 kHz clock (5 V logic level) in the device under test (NT).

## 120 KHZ

The phase jitter is measured at a 120 kHz clock (5 V logic level) in the device under test (NT).

## 256 KHZ

The phase jitter is measured at a 256 kHz clock (5 V logic level) in the device under test (NT).

## 512 KHZ

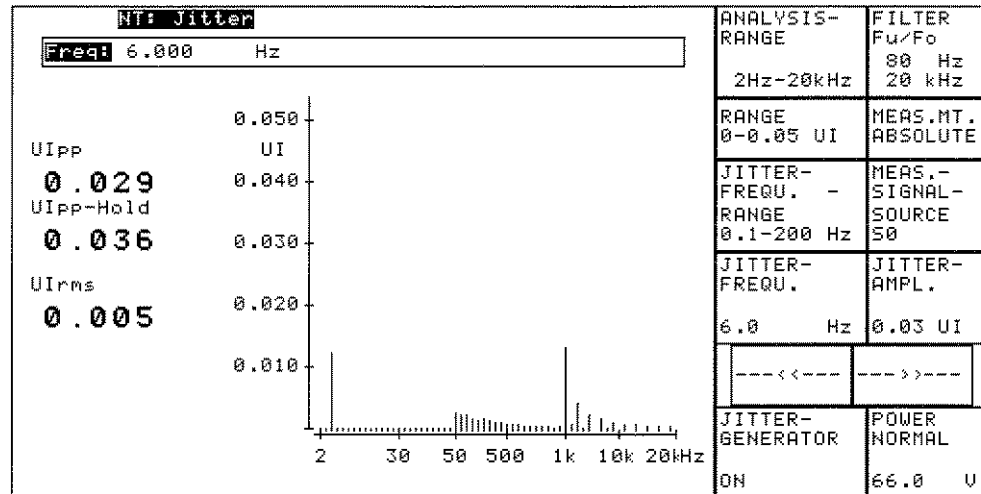
The phase jitter is measured at a 512 kHz clock (5 V logic level) in the device under test (NT).

## jitter generator

Switching the jitter generator on or off.

## JITTER GENERATOR ON

Having switched on the jitter generator you will obtain the following additional setting options:



## JITTER FREQUENCY

You can set the following frequency ranges: 0.1 Hz - 200 Hz and 200 Hz to 20 kHz.

## JITTER DEVIATION

For the frequency range 0.1 to 200 Hz, a jitter deviation of  $0.002 U_{I_{ss}}$  to  $0.4 U_{I_{ss}}$  can be set in steps of  $0.002 U_{I_{ss}}$ .

For the frequency range 200 Hz to 20 kHz, a deviation of  $0.001 U_{I_{ss}}$  to  $0.02 U_{I_{ss}}$  can be set in steps of  $0.001 U_{I_{ss}}$ .

## ABSOLUTE MEASUREMENT / RELATIVE MEASUREMENT

The following settings are possible:

## ABSOLUTE JITTER MEASUREMENT

The measuring signal is demodulated on the basis of a reference signal derived from the unjittered master clock (M-CLK/15.36 MHz). It is displayed in the form of a phase jitter.

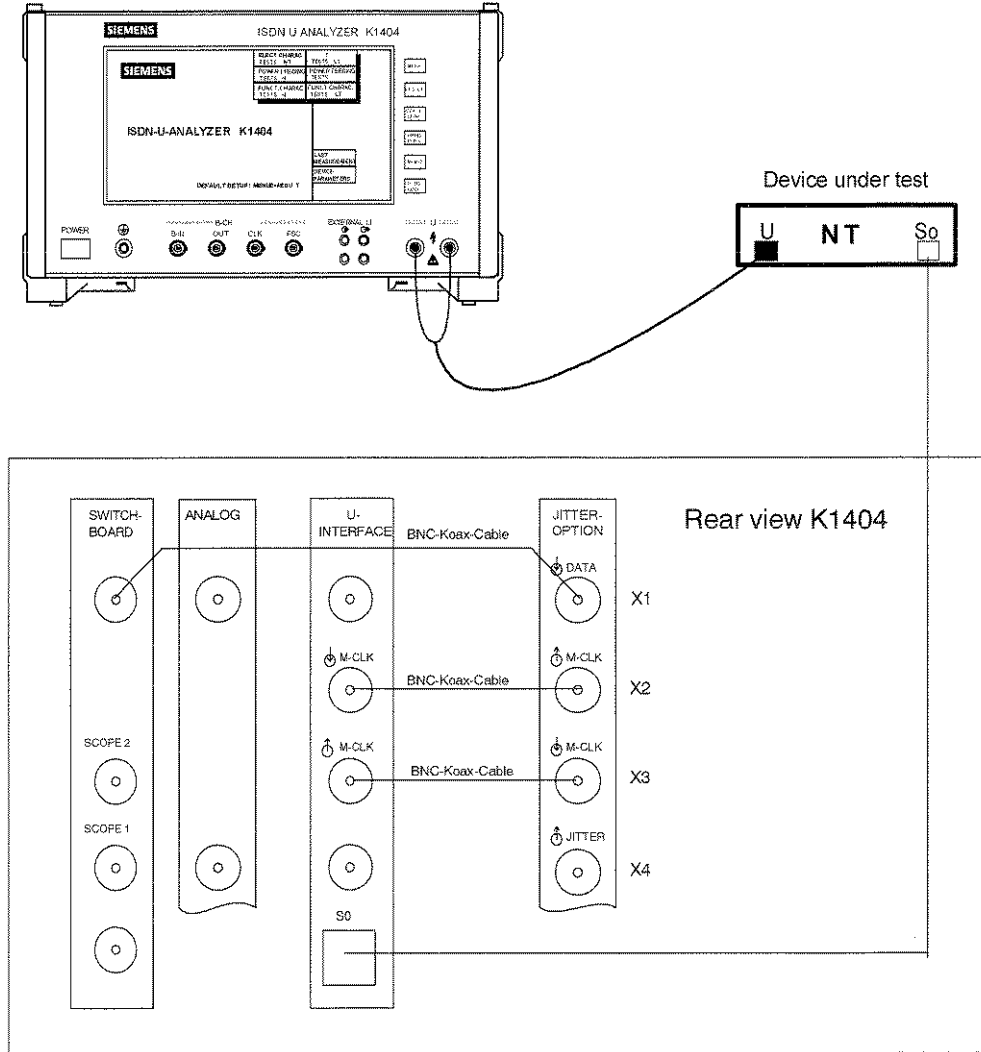
## RELATIVE JITTER MEASUREMENT

The measuring signal is demodulated on the basis of a reference signal derived from the jittered master clock (M-CLK/15.36 MHz). It is displayed in the form of a phase jitter.

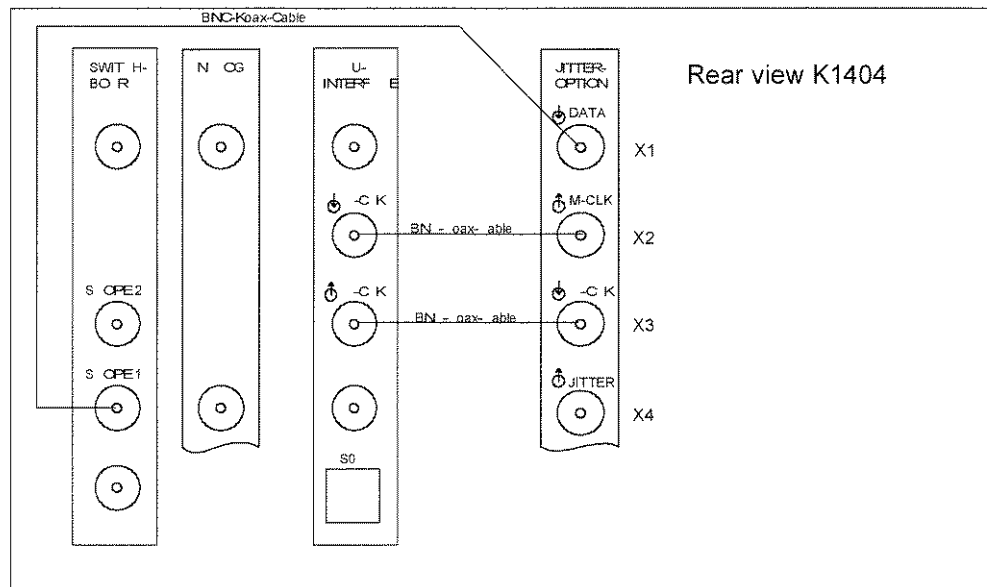
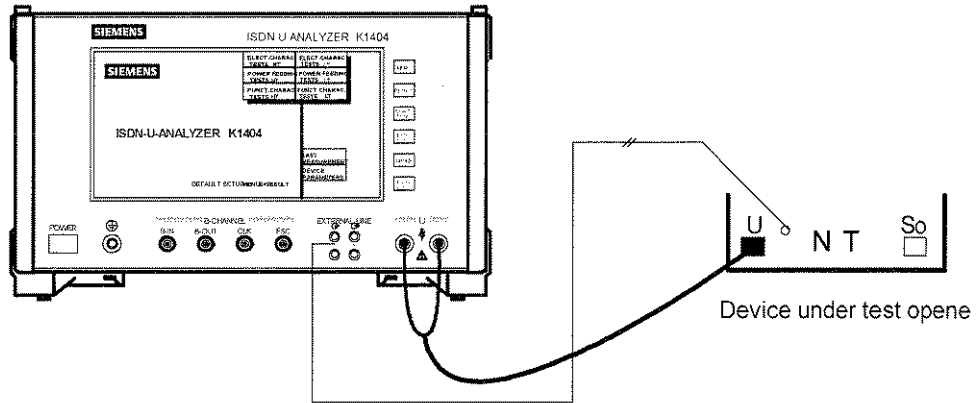
### Test set-up

Depending on the measuring signal source, the device under test must be connected with K1404 as follows:

MEASURING SIGNAL SOURCE s0

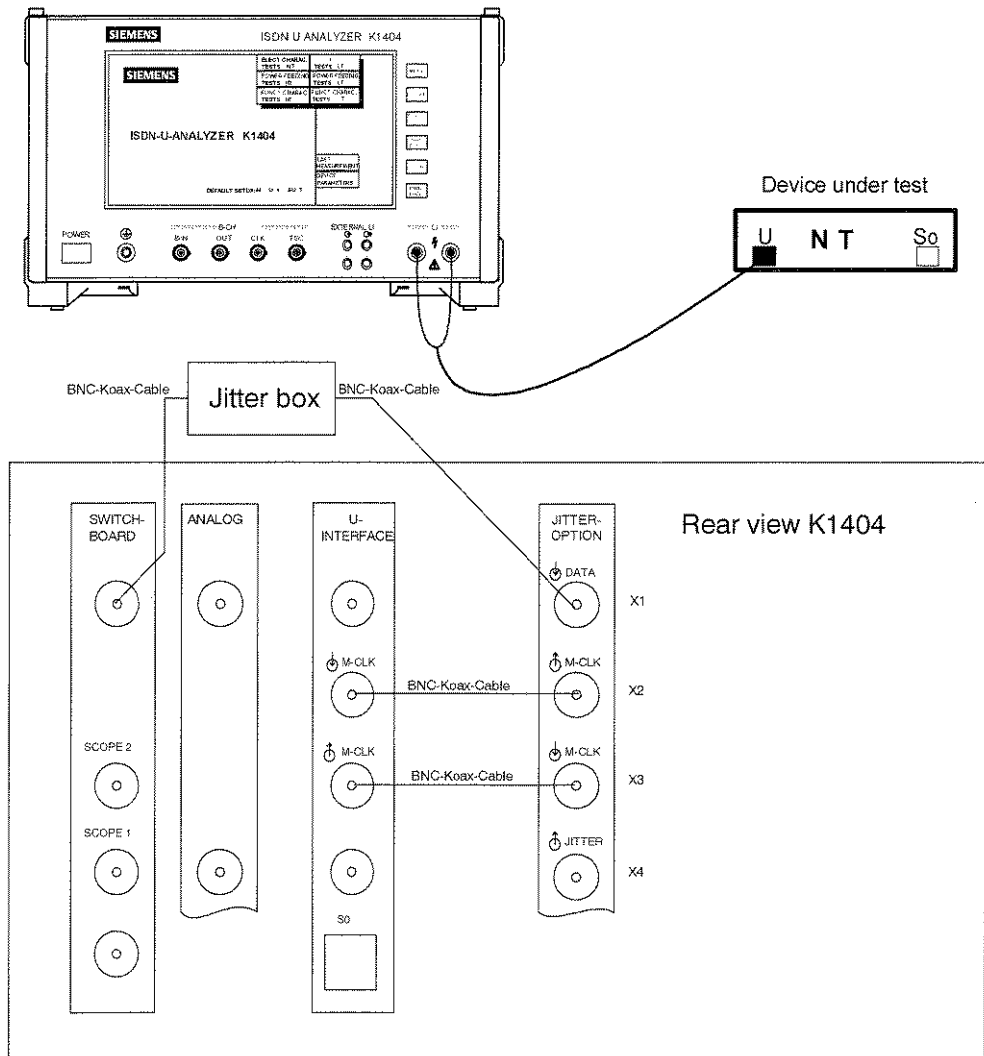


MEASURING SIGNAL SOURCE 80 kHz, 120 kHz, 256 kHz AND 512 kHz



The socket pair EXTERNAL LINE INPUT is connected with a measuring point (80 kHz, 120 kHz, 256 kHz or 512 kHz with 5 V logic level) and with the internal ground of the device under test via a twin-core measuring line.

MEASURING SIGNAL SOURCE U (WITH Jitter box)



**Measurement**

Start the measurement via the START/STOP key.

First, the module JITTER is initialized. Then, the following status message "INIT/START" is displayed:

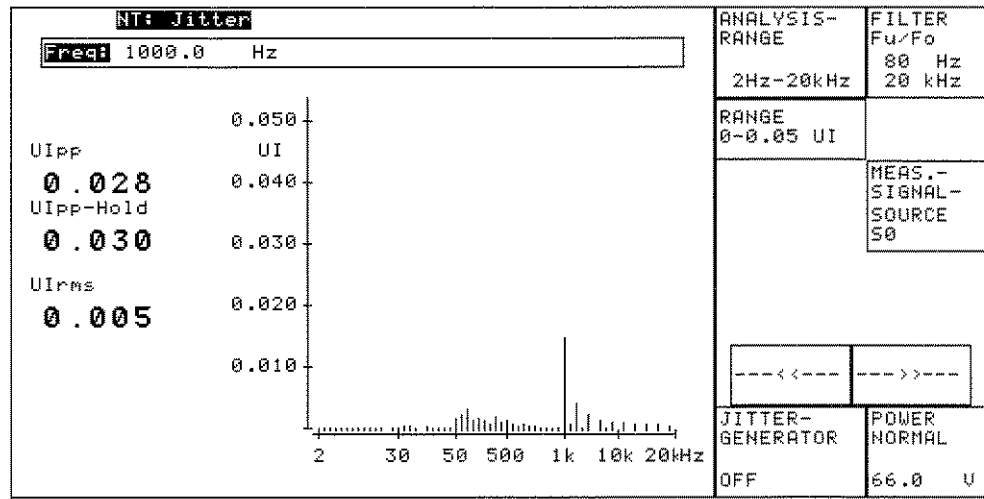
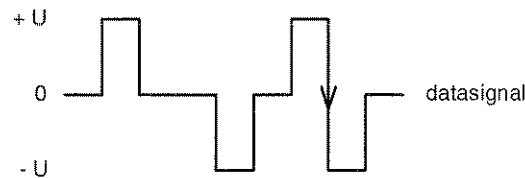
Afterwards, the device under test is activated by way of the U interface module. The activation of the NT necessary for jitter measurement is carried out automatically. Following successful activation the jitter measurement is started. The actual start of the measurement is indicated by "MEASURE".

A complete measuring cycle within the selected frequency range inclusive of all calculations, evaluations and the graphic output on the display takes some 1.3 seconds.

Stop the measurement via the START/STOP key. The status message "STOP" will appear in the display.

The device under test remains activated until you exit Jitter Measurement.

The input circuit of the phase jitter meter is configured such that the negative going transition of the data signal from +U to -U is used for jitter evaluation.



Here, a distinction between absolute and relative jitter measurement is applicable:

- Absolute jitter measurement: The unjittered system clock is used as a reference for establishing the measured values.
- Relative jitter measurement :The jittered transmission signal is used as a reference for establishing the measured values.

### Result structure

The measured results are displayed in either alphanumeric or graphic form. Numeric display is in the form "0. n1 n2 n3 UI". The following measured values are displayed:

- Peak value (peak-peak) 0. x1 x2 x3  $U_{I_{ss}}$
- Maximum value of the last 20 measurements 0. y1 y2 y3  $U_{I_{ss}}\text{-Max}$
- Effective value 0. z1 z2 z3  $U_{I_{eff}}$

The display in graphic form is intended for the qualitative evaluation. Within the range of 2 Hz to 20 kHz the phase jitter which has been converted to alternative voltage in the jitter modulator is evaluated without filtering by means of a digital signal analysis.

The analysis range is divided into four ranges of differing frequency grid. The frequency of the lines can be read out by means of a cursor; the  $U_{I_{ss}}$  value can be estimated from the diagram.

- Frequency range II comprise the range 10 Hz to 200 Hz with a line grid of 10 Hz and is mainly suited for analysis of system disturbances and their harmonic waves.
- Frequency range I comprises the range 2 Hz to 20 kHz including the three partial ranges a, b and c.



In the following examples, the values are given in % $U_{I_{ss}}$ .



**Frequency range II:** The amplitude-modulated phase jitter is analyzed in the frequency range from 10 Hz to 200 Hz and is graphically displayed in a line spectrum of 20 lines in intervals of 10 Hz. If a jitter frequency exactly matches one of the lines, this frequency will be exactly presented by this line with regard to both amplitude and frequency:

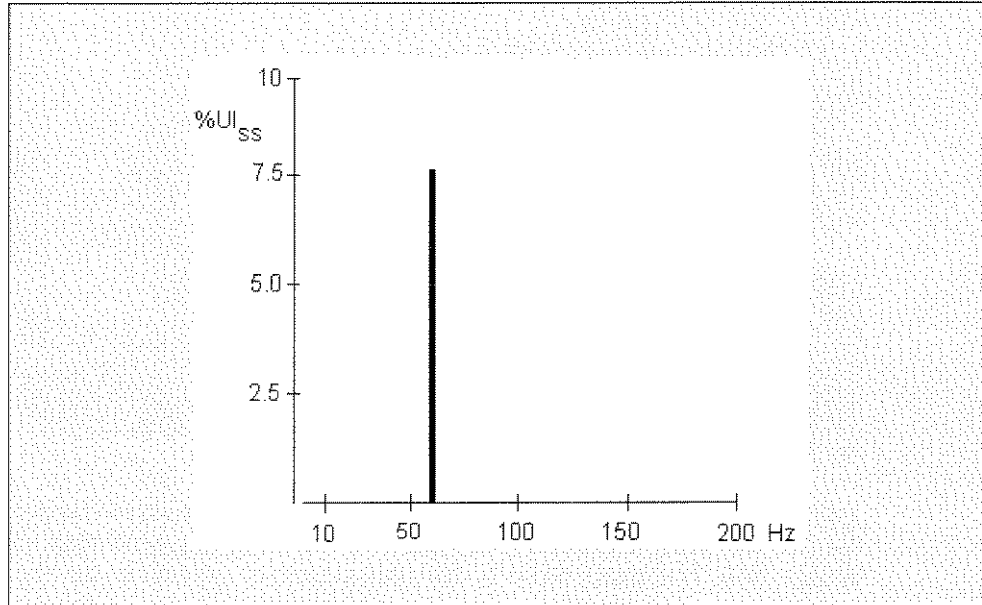


Fig. 8.1: Jitter frequency: 50 Hz; jitter amplitude : 7.5% UI<sub>SS</sub>

If the jitter frequency does not exactly match any of the lines, two adjoining spectral lines of differing amplitude as well as several exponentially decaying lines will result. The amplitude of the latter reaches a maximum when the frequency to be analyzed is located exactly between two lines. In this case the amplitudes of the two adjoining spectral lines have the same mean value. The exact value of the jitter frequency amplitude (45 Hz) is obtained from:

$$U_{\Sigma} = \sqrt{U_1^2 + U_2^2}$$

The exponentially decaying lines can be neglected when amplitudes are evaluated.

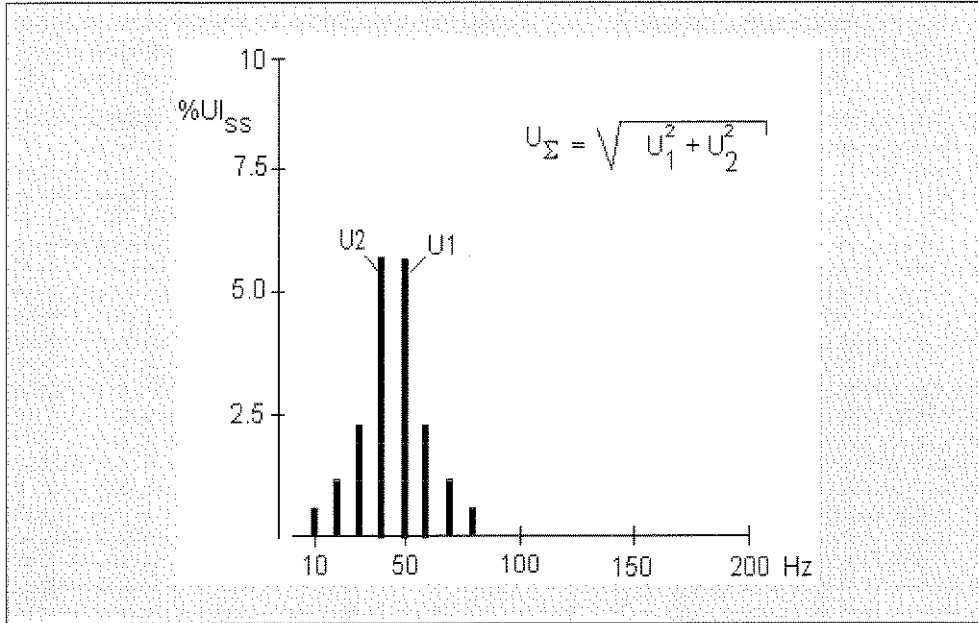


Fig. 8.2: Jitter frequency: 45 Hz; jitter amplitude : 7.5% UI<sub>SS</sub>

If the jitter frequency (49 Hz) is in close vicinity of a line spectrum frequency (50 Hz), the grid line which is closer to the frequency has a higher amplitudinal value than the second one. The exact value of the jitter frequency amplitude (49 Hz) is obtained from:

$$U_{\Sigma} = \sqrt{U_1^2 + U_2^2}$$

Here, the decay rate of the exponentially decaying lines is higher than in the previous figure.

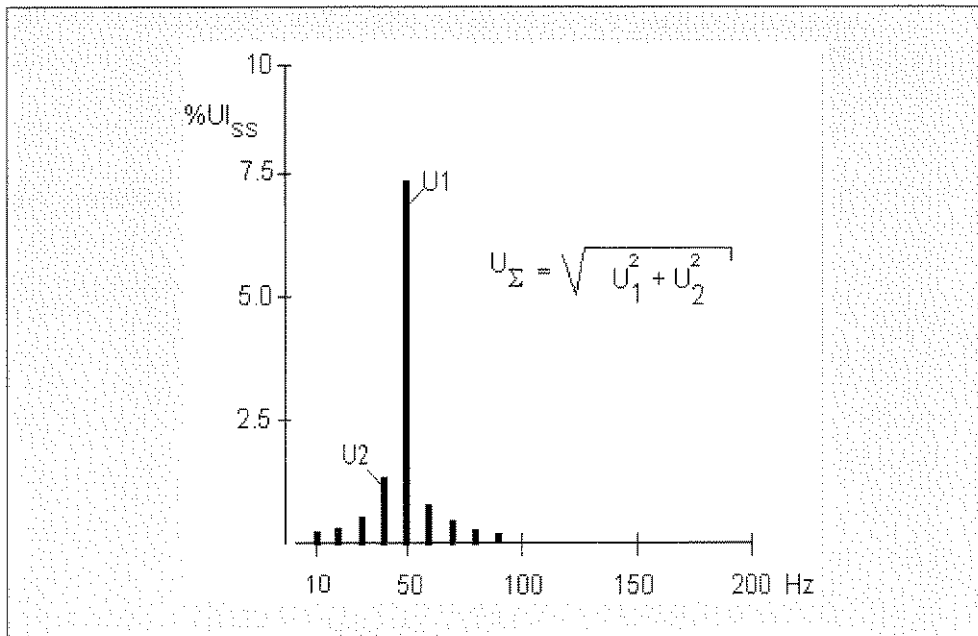


Fig. 8.3: Jitter frequency: 49 Hz; jitter amplitude : 7.5% UI<sub>SS</sub>

**Frequency range I (partial range a: 2 Hz to 50 Hz):** The amplitude-modulated phase jitter is analyzed in the frequency range from 2 Hz to 50 Hz and is graphically displayed in a line spectrum of 25 lines in intervals of 2 Hz:

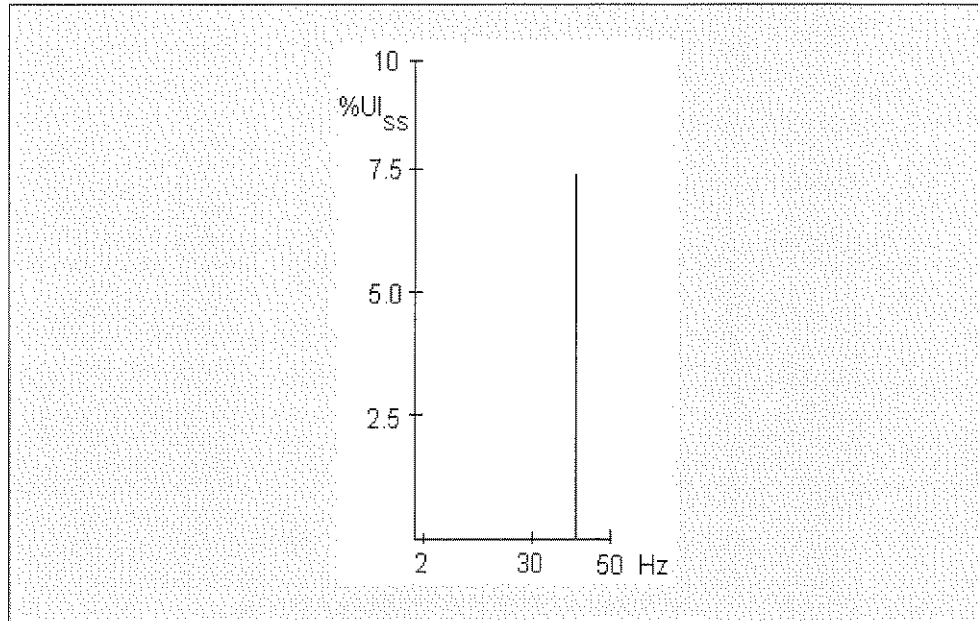


Fig. 8.4: Jitter frequency: 40 Hz; jitter amplitude: 7.5%  $U_{SS}$

**Frequency range I (partial range b: 50 Hz bis 1 kHz):** The amplitude-modulated phase jitter is analyzed in the frequency range from 50 Hz to 1 kHz and is graphically displayed in a line spectrum of 20 lines in intervals of 50 Hz. A jitter frequency which corresponds to a line spectrum frequency is represented in its exact amplitude. Other frequencies are evaluated and displayed as in "frequency range II":

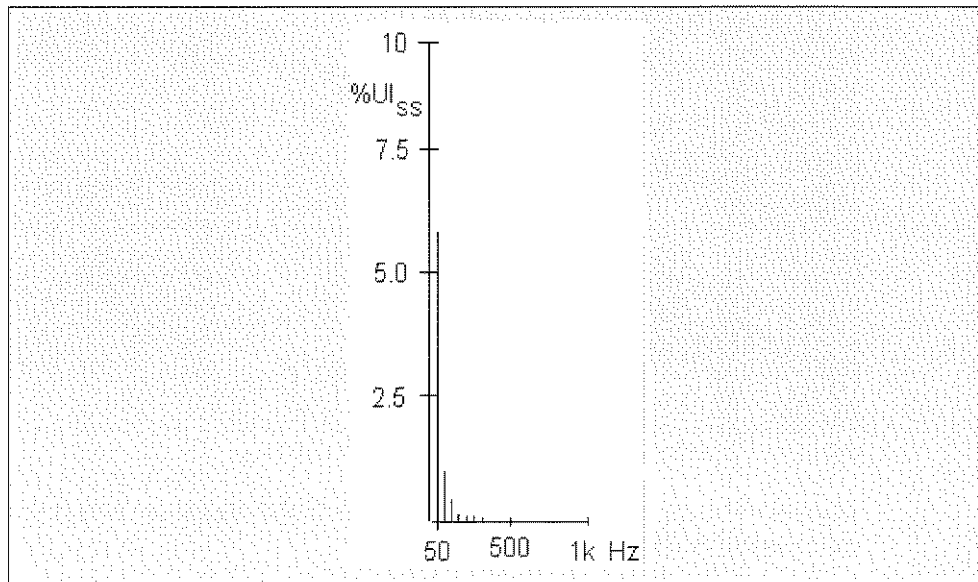


Fig. 8.5: Jitter frequency: 40 Hz; jitter amplitude: 7.5%  $U_{SS}$

The jitter frequency of 40 Hz does not tally with any of the spectrum lines and is therefore rated with a lower value.

**Frequency range I (partial range c: 1 kHz to 20 kHz):** The amplitude-modulated phase jitter is analyzed in the frequency range from 1 kHz to 20 kHz and is graphically displayed in a line spectrum of 20 lines in intervals of 1 kHz:

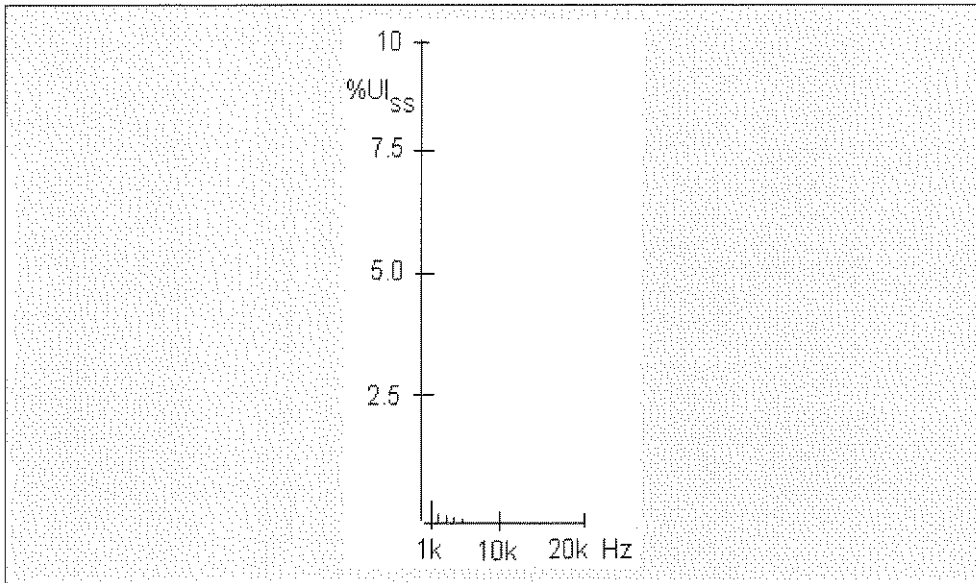


Fig. 8.6: Jitter frequency: 40 Hz; jitter amplitude: 7.5% U<sub>SS</sub>

The jitter frequency of 40 Hz does not tally with any of the spectrum lines and is therefore rated with an even lower value than in the previous figure.

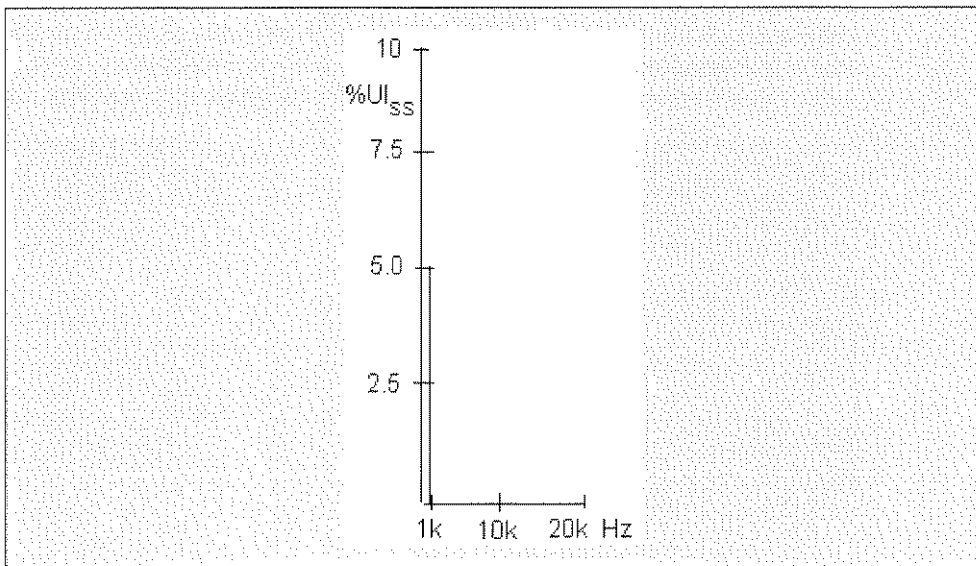


Fig. 8.7: Jitter frequency: 1 k Hz; jitter amplitude: 5% U<sub>SS</sub>

The jitter frequency of 1 kHz matches a line of the spectrum and is therefore rated with respect to its full amplitude.

**Frequency range I (total range: 2 Hz to 20 kHz):** For a better overview, the partial ranges a to c are combined and displayed in a single diagram.

In the case of phase jitter frequencies of 40 Hz and 1 kHz, respectively, all the lines of the partial ranges a to c are contained in the general view. The 1 kHz line is superimposed by a very small spectral line stemming from the 40 Hz spectrum. Due to the quadratic rating this error is so minor that it can be neglected. A thick bar underneath the partial range c (1 kHz to 20 kHz) marks the superimposition by the spectral line at 13 kHz:

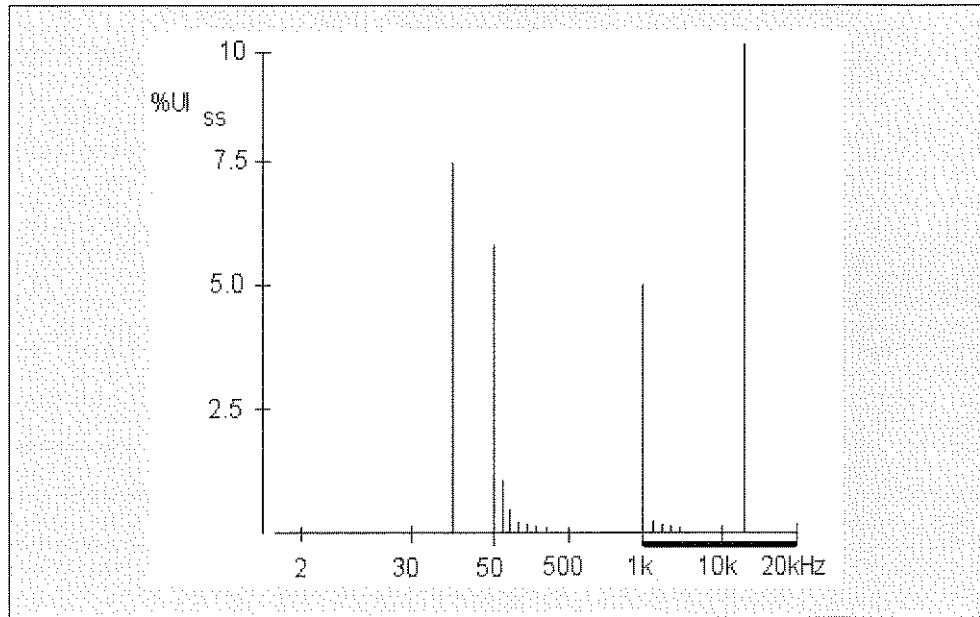


Fig. 8.8: Jitter frequency: 40 Hz; jitter amplitude: 7.5% UIss and  
1 kHz, jitter amplitude: 5.0% UIss  
13 kHz, jitter amplitude: 15% UIss

**Measurements at the jitter demodulator output**

The output of the jitter demodulator for measurements with external measuring devices is provided by the BNC socket JITTER. The phase jitter of the device under test can either be analyzed here in its time range by means of an oscilloscope or in its frequency range by means of a spectrum analyzer.

**Measurements by oscilloscope:** Connect an oscilloscope with an internal resistor of  $\geq 50$  ohms to the output JITTER of the jitter module and start the measurement with the desired parameter settings. The display of the oscilloscope will allow you to evaluate line profile, frequency and peak value of the measured phase jitter.

Conversion between measuring voltage at the oscilloscope and phase jitter is according to the equation:

$$D_j = k \cdot U$$

$D_j$

Phase jitter of the device under test in  $U_{ISS}$

$U$

Voltage  $U_{SS}$  at oscilloscope in V

$k$

Conversion factor in  $U_{ISS}/V$

Measuring range K1404:	k in $U_{ISS}/V$ :
0 to 0.1 $U_{ISS}$	0.017857 $\pm 3\%$
0 to 0.05 $U_{ISS}$	0.017857 $\pm 3\%$

A measurement featuring an ISDN telephone as the device under test is displayed in the following form:

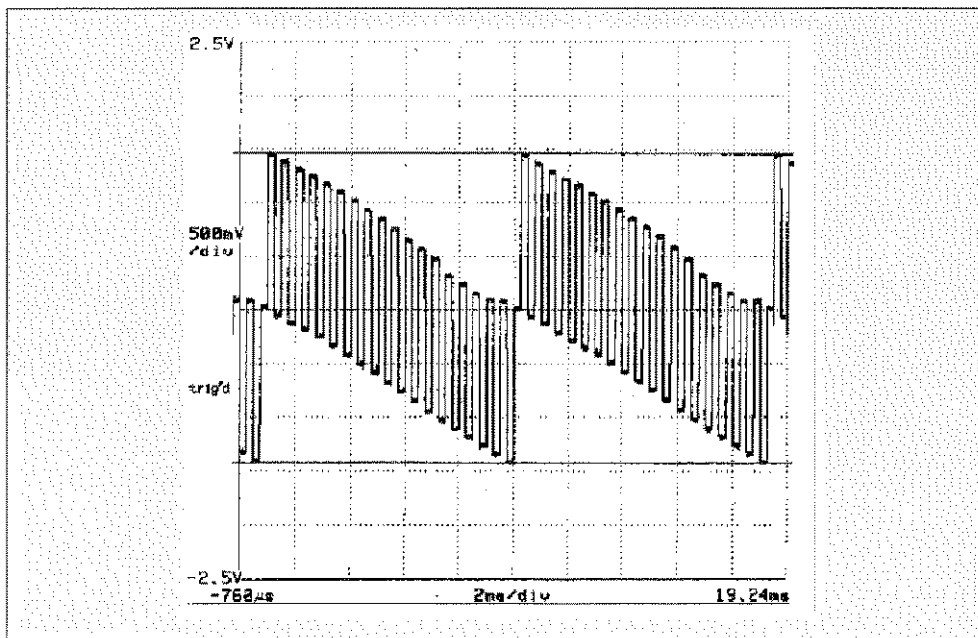


Fig. 8.9: Device under test ISDN telephone; oscilloscopic display of phase jitter with 2ms/div time range

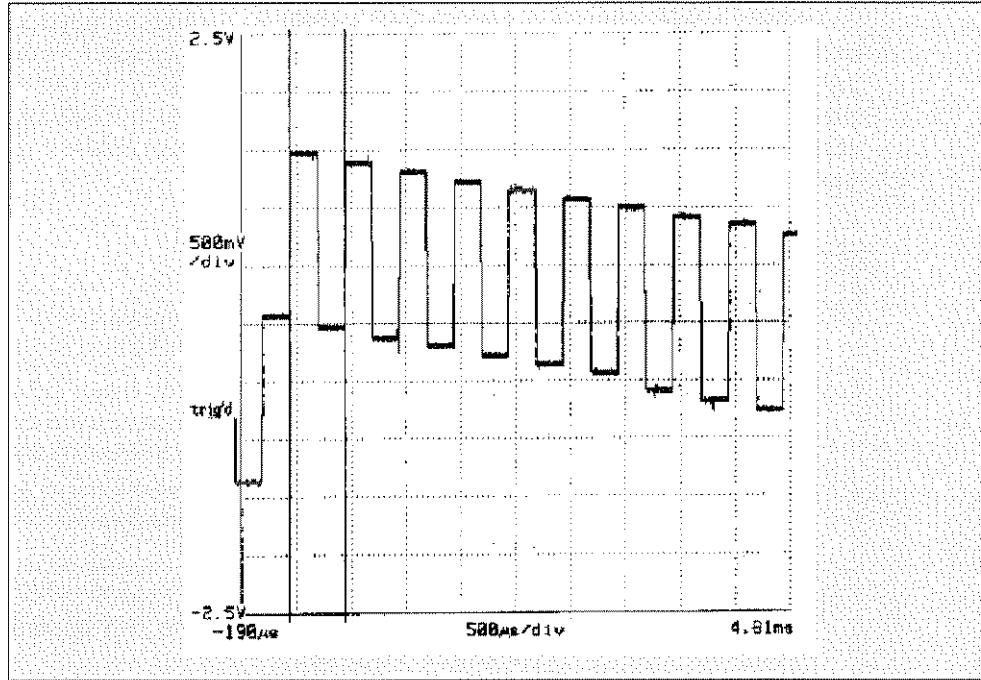


Fig. 8.10: Device under test ISDN telephone; oscilloscopic display of phase jitter with 500ms/div time range

The displayed function of the phase jitter measured at the device under test (transmitting side of the ISDN telephone) consists of a saw-tooth function with a frequency of approx. 107 Hz (see figure above) and a symmetrical rectangle with a frequency of 2 Hz (see figure below). The phase jitter of the saw-tooth function amounts to  $(1.46V \cdot 1.786 \% U_{ISS}/V)$  approx.  $2.6\% U_{ISS}$ . The phase jitter of the rectangular function amounts to  $(1.4V \cdot 1.786 \% U_{ISS}/V)$  approx.  $2.5\% U_{ISS}$ . A phase jitter of approx.  $5.1\% U_{ISS}$  results.

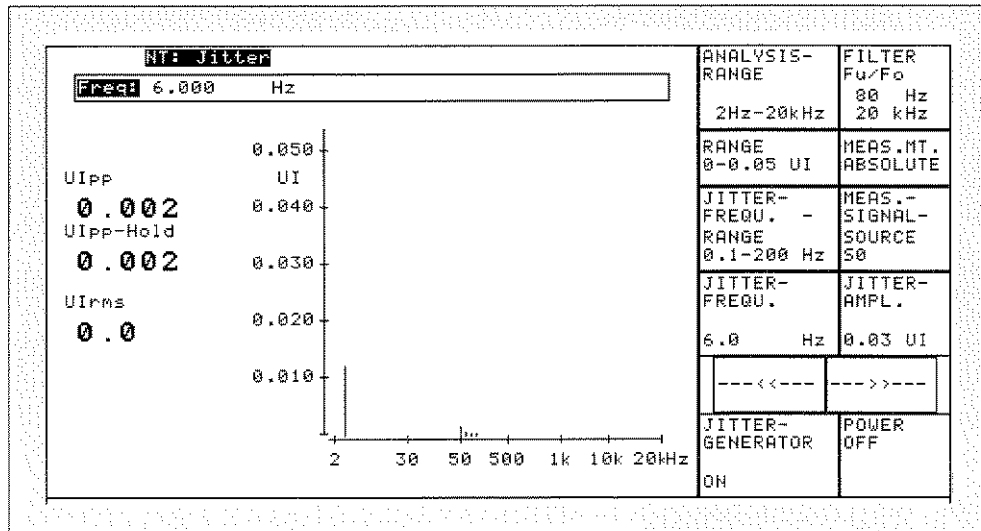


Fig. 8.11: Device under test ISDN telephone; display of phase jitter at K1404

The peak-to-peak evaluation, the maximum peak-to-peak evaluation comprising 20 measurements as well as the effective evaluation of the measured phase jitter can be read on the K1404 display. In addition, the spectrum lines of the phase jitter can be read from a diagram using the cursor.

The peak-to-peak value of the phase jitter cannot be derived from the spectral lines, because the phase information between the individual spectral lines is missing. Within the spectrum, the 6 Hz line generated by the jitter generator can be seen clearly. The clock recovery in the device under test reduces the  $0.03 U_{i_{ss}}$  jitter deviation of the generator by  $0.022 U_{i_{ss}}$  to  $0.008 U_{i_{ss}}$ . This corresponds to a jitter suppression of 11.5 dB for a frequency of 6 Hz.

### Error messages

NO SIGNAL	After the start no signal is displayed during the synchronization process and when the data signal is missing.
JIT: NO MEASURING	The jitter measurement is due to begin but cannot be started owing to a setting or parameter error. In this case the measurement must be stopped and restarted. If the error is continuously displayed, either the jitter module or the main CPU is defective. (IEC error no. 302)
JIT: SET UP ERROR	Like JIT: NO MEASURING, however, without activated jitter measurement; i.e. only the jitter generator is used. (IEC error no. 304)
ERROR ON U	The U interface cannot be activated.
DEACTIVATED	The device under test was deactivated by the Functional Tests module.



### Calculation of the jitter transmission function

The following paragraphs will tell you how to calculate the jitter transmission function from the measurements ABSOLUTE JITTER MEASUREMENT and RELATIVE JITTER MEASUREMENT.

#### ABSOLUTE JITTER MEASUREMENT (JITTER GENERATOR ON)

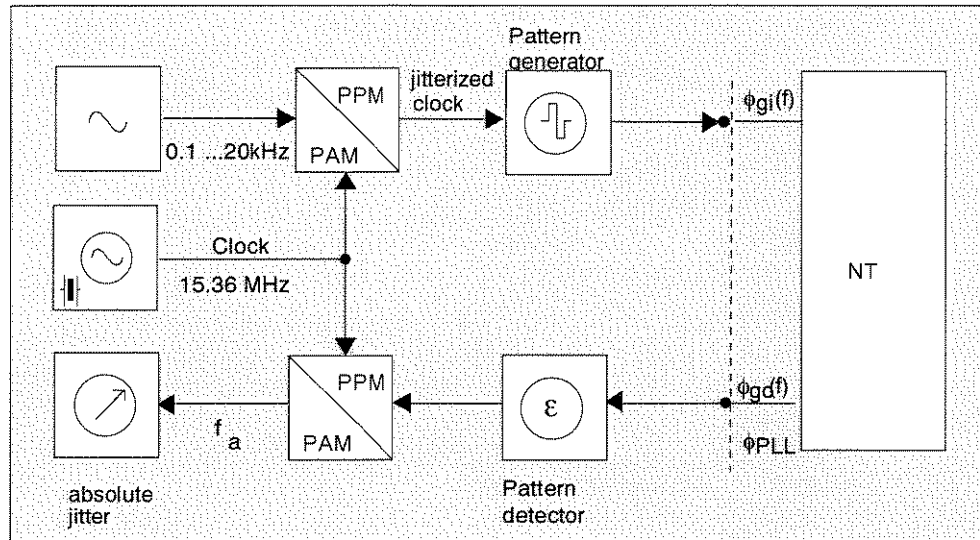


Fig. 8.12: Measurement configuration

$\phi_a$   
absolutely measured phase jitter

$\phi_{gi}(f)$   
phase jitter of the jitter generator at the input of the NT with frequency (f)

$\phi_{go}(f)$   
residual phase jitter of the jitter generator at the output of the NT with frequency (f)

$\phi_{PLL}$   
phase jitter caused by the clock recovery circuit in the NT

If ABSOLUTE JITTER MEASUREMENT is selected, the unjittered clock of 15.36 MHz is used both in the jitter modulator for generating a defined jittered clock and in the jitter demodulator as a reference clock for jitter demodulation. The clock of the pattern generator (80 kHz) is derived from the jittered clock of 15.36 MHz so that the data stream to the NT is jittered in defined form with the jitter  $\phi_{gi}(f)$ .

In the NT, the clock for the transmission data is recovered from the jittered data stream in a clock recovery circuit (PLL) which partly suppresses the jitter of the receiving data. The transmission data contains the unsuppressed residual jitter  $\phi_g(f)$  of the receiving data as well as an additional jitter  $\phi_{PLL}$  resulting from the clock recovery.

In the jitter demodulator, the data stream with the jitter ( $\phi_g(f) + \phi_{PLL}$ ) is demodulated by means of the jitter-free clock of 15.36 MHz and is displayed on the device as "absolute jitter".

The following equation applies to the absolute phase jitter:

$$\phi_a = \phi_{g0}(f) + \phi_{PLL}$$

RELATIVE JITTER MEASUREMENT (JITTER GENERATOR ON):

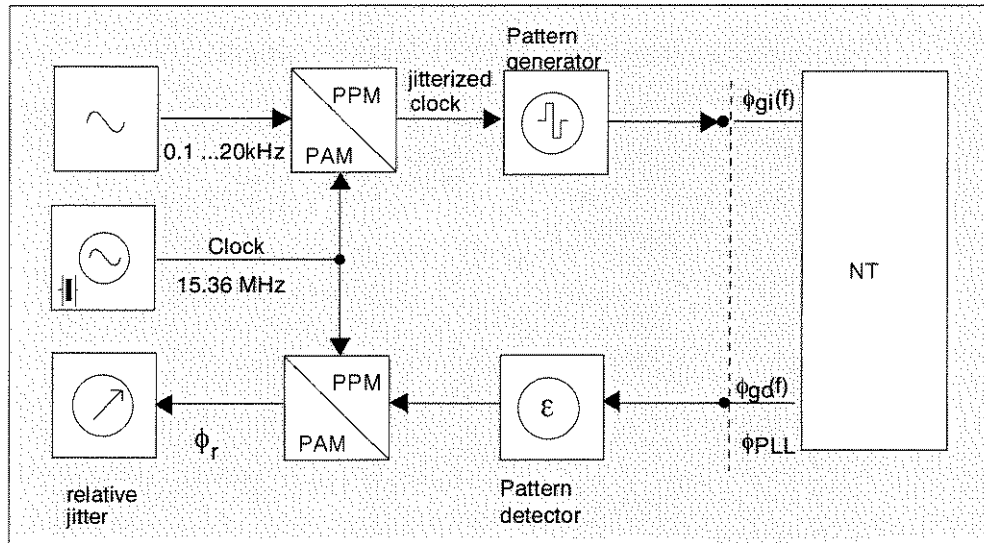


Fig. 8.13: Measurement configuration

$\phi_r$   
relatively measured phase jitter

$\phi_{gi}(f)$   
phase jitter of the jitter generator at the input of the NT with frequency (f)

$\phi_g(f)$   
residual phase jitter of the jitter generator at the output of the NT with frequency (f)

$\phi$   
phase jitter caused by the clock recovery circuit in the NT

If RELATIVE JITTER MEASUREMENT is selected, the unjittered clock of 15.36 MHz is used in the jitter modulator for generating a defined jittered clock. This jittered clock is used in the jitter demodulator as reference clock for the jitter demodulation. The clock of the pattern generator (80 kHz) is derived from the jittered clock of 15.36 MHz so that the data stream to the NT is jittered in defined form with the jitter  $\phi_{gi}(f)$ .

In the NT, the clock for the transmission data is recovered from the jittered data stream in a clock recovery circuit (PLL) which partly suppresses the jitter of the receiving data. The transmission data contains the unsuppressed residual jitter  $\phi_g(f)$  of the receiving data as well as an additional jitter  $\phi$  resulting from the clock recovery.

In the jitter demodulator, the data stream with the jitter ( $\phi_g(f) + \phi$ ) is demodulated by means of the jittered clock of 15.36 MHz and is displayed on the device as "relative jitter". In the event of an ideal jitter suppression by the clock recovery circuit, the measured relative jitter corresponds to added values of the phase jitter of the jitter generator ( $\phi_{gi}(f)$ ) and the jitter ( $\phi$ ) resulting from the clock recovery. The following equation applies to the measured relative jitter  $\phi_r$ :

$$\phi_r = \phi_{gi}(f) - \phi_{g0}(f) + \phi_{PLL}$$

### Calculation

The residual jitter  $\phi_g(f)$  and the jitter transmission function  $F_j(f)$  of the clock recovery circuit in the NT can be calculated on the basis of the measurement of the absolute and relative jitters with reference to the following formulas. Here, both the residual jitter and the jitter transmission are a function of the jitter frequency of the jitter generator:

$$\phi_{g0}(f) = \frac{\phi_{gi}(f) + \phi_a - \phi_r}{2}$$

and

$$F_j(f) = 20 \lg \frac{2\phi_{gi}(f)}{\phi_{gi}(f) + \phi_a - \phi_r}$$

$\phi_a$   
absolutely measured phase jitter

$\phi$   
relatively measured phase jitter

$\phi_{gi}(f)$   
set phase jitter of the jitter generator at the input of the NT with frequency (f)

$\phi_g(f)$   
residual phase jitter of the jitter generator at the output of the NT with frequency (f)

$F_j(f)$   
jitter transmission function



## 9 Remote control operation of K1404

In this chapter you will learn how to remote-control K1404 in all its functions via the IEC interface.

## 9.1 Preparation: Remote control

Before operating the K1404 under remote control via the IEC interface, check or set the device address in the basic menu under `DEVICE PARAMETER: IEC BUS ADDRESS` (default address = 17). Addresses may be set between 1 and 30.

If a new address is selected, the unit must be switched off and on in order to initialize the IEC bus interface with this address.

Remote control operation is indicated by an "R" (Remote) on the display.



If several devices are connected to the IEC bus, a different address must be set for each one.

When sending commands to the device the sign 'LF' (0A hexadecimal) must be used as end label (EOI). The device also uses this sign for data output.

If several devices are connected to the IEC bus, you must observe that every device is set to another address.

## 9.2 Overview of commands in functional groups

The following tables offer an overview of commands arranged according to functional groups.

### K1404 setting commands

Set the clock in K1404	TIME
Poll the clock in K1404	TIME?
Set the date in K1404	DATE
Poll the date in K1404	DATE?
Set the language of the device	LANGUAGE
Poll the language set in the device	LANGUAGE?
Set the IEC bus address	IEEE_ADDRESS
Poll the IEC bus address	IEEE_ADDRESS?

**Measuring commands**

Start measurement	START
Stop measurement	STOP
Poll the status of the device	RUNNING?
Set the parameters for measurement	MEASURE
Poll the measurement parameters	MEASURE?
Read the online measurement results	TRACE?
Clear the trace memory	CLEAR_TRACE
Functional tests: reading out the results	EXT_TRACE?
Read out the measurement results after STOP	RESULT? 0   1
Read out the status information from the status ring list	READ_STATUS?
Clear the status ring list	CLEAR_STATUS
Trigger an action (specific to measurement)	UPDATE
Selection functional test module	CODE_SET
Output a hardcopy (via RS 232)	PRINTOUT 0   1

**IEC standard commands: General management**

Clear the status byte and the event registers	*CLS
Switch on the remote control	*RON
Switch off the remote control	*ROF
Poll the device identification	*IDN?
Poll the parameter set	*LRN?

**IEC standard commands: Event and status management**

Set the event status enable register	*ESE
Clear the event status enable register	*ESE?
Read the event status enable register	*ESR?
Set the parallel poll enable register	*PRE
Read the parallel poll enable register	*PRE?
Set the service request enable register	*SRE
Read the service request enable register	*SRE?
Read the status byte	*STB?
Read the parallel request bit	*IST?
Set operation complete flag	*OPC
Trigger operation complete reaction	*OPC?
Set the event enable register A	ERAE
Read the event enable register A	ERAE?
Read the event register A	ERA?
Set the event enable register B	ERBE
Set the event enable register B	ERBE?
Read the event register B	ERB?



The following pages describe the individual commands in greater detail.

The IEC standard commands: event and status registers are described at the end of chapter 9 in a separate section under "Event and status management".



## 9.3 Command description

All device settings and feedbacks are triggered by character strings. The commands can be entered directly via the keyboard. As for the general **command syntax**: The command names are based on the English terms for the relevant functions. For example, the command `START` triggers the start of a measurement at the device.

All command names which effect the poll of a device setting are terminated by '?' (question mark). The request command `RUNNING?` for example, checks the current status of the measuring cycle.

K1404 sends a feedback to the controller as reaction to a request command. By polling the status byte or by carrying out a serial poll you can determine whether a device message is present: bit 4 (=16) in the status byte is set in this case ( `MAV`: Message AVailable ).

A command consists of a header (command name) and one or more numerical parameters where applicable. The header must be entered in upper-case letters. At least one space must be entered between the command header and the parameters. If there are several parameters, they are separated by commas (','). Example:  
`TIME 12,00,00`

Numerical parameters may be entered as integers, fixed-point numbers or floating-point numbers with or without exponents. The exponent may comprise up to two digits, the exponent symbol 'E' must be in upper case. A space may be entered before and after the exponent symbol. Plus signs may be omitted. The parameter 12.5 for example, can be represented as follows:: 12.5 or 0012.5 or 1.25E1 oder +1.25E+01.

It is possible to transmit several commands in one string. The commands are separated by a semicolon (;). Spaces may be entered before and after the semicolon. Example: `TIME?; RUNNING? ; START`

Incorrect entries and commands which cannot be executed generate an error message. This causes a certain bit to be set in an event register. The controller can then read the register to determine the type of error which has occurred.

The following overview is arranged in the alphabetical order of the command names.

**\*IDN?**

Output of the identification character string of the device.

The output is structured according to the following example:

```
SIEMENS,7KK1404,
rrttuuvvwwxx.aaa/bbb/ccc/ddd/eee/fff/FFF/

rr      Hardware version main processor
tt      Hardware version ANALOG1
uu      Hardware version FUNCTIONAL TESTS (1) (OPT)
vv      Hardware version FUNCTIONAL TESTS (2)(OPT)*
ww      Hardware version POWER
xx      Hardware version JITTER
aaa     Firmware version main processor
bbb     Firmware version ANALOG1
ccc     Firmware version FUNCT1 (2B1Q)
ddd     Firmware version FUNCT1 (4B3T)
eee     Firmware version POWER
fff     Firmware version JITTER (1)
FFF     Firmware version JITTER (2)
```

If no optional modules are available, it is indicated by '-'.

**\*ROF**

The device is deactivated for operation via remote control. R is blanked in the upper left corner of the display.

**\*RON**

The device is activated for operation via remote control. R appears in the upper left corner of the display.

**CLEAR\_STATUS**

Clears the status information ring list.

This command is used to clear the status ring list if the device is operated via remote control.

**CLEAR\_TRACE**

Clears the ring list for trace test results.

Clears the information in the ring list of 4 test results.  
Attention: The command does not initiate the reset of the status register for „Trace available“ (ERA register), i.e. if the command 'Clear\_Trace' is carried out during measurement, this must be taken into account during program set-up.

---

**CODE\_SET n**

Selection of the interface in the device

n=0 --&gt; interface 4B3T

n=1 --&gt; interface 2B1Q

n=2 --&gt; interface Up0

Example:

CODE\_SET 1

CODE\_SET? --&gt; 1 (2B1Q)

---

**DATE dd,mm,yy**

Sets the date in K1404: the command sets the date of the real-time clock in K1404. The date is currently only used in connection with the command RESULT 0|1.

Parameter description:

dd day

mm month

yy year

Example:

DATE 19,03,93

DATE? --&gt; +19,+3,+93

**EXT\_TRACE? <Index>**

Reads out the ASCII trace lines for functional tests. If the device is performing functional tests in remote control status in the test mode `Functional Tests`, the result lines are written to an internal trace buffer of 320 lines. Using this command, result lines can be obtained from the device. An ASCII data format is used for the results:

```
ARBITRARY BLOCK PROGRAM DATA
ANSI/IEEE Std 488.2) <#> <XA>
<XB1> <XB2>... <XBn>
<Byte 1>
<Byte 2>.... <Byte n>
```

**Description:**

```
{#}      Preamble
{XA}     Length of length data in bytes (in ASCII code)
{XB1} ..{XBn}   Number of data bytes
                    (in ASCII code)
{> = < BYTE1}  Number of lines obtained or
                    not yet obtained or
                    not ready for output.
{Byte 2}..{Byte n} Result lines in ASCII code
```

**Data types:**

**BYTE** = 8Bit (MSB.....LSB)

The command index can range from 0 to 60. Use the index to indicate how many result lines you want to obtain. If 0 is selected as index, all result lines since the last `EXT_TRACE` request are output and the information for byte 1 is = Numb. of lines, if 60 or less result lines are present, or > Numb. of lines if more than 60 result lines are present.

Result lines which were already obtained cannot be requested again.

If a value between 0 and 60 is selected as index, all lines since the last `EXT_TRACE` request are output. The response if index equals the number of present lines is: = Numb. of lines, or: < Numb. of lines, if the index number is greater than the number of present lines, or: > Numb. of lines, if the index number is lower than the number of present lines.

The output can be obtained either during or after a measurement. For an output after `STOP`, the device must still be set in its recent measurement mode. Once a different measurement is selected, output is no longer possible.

**IEEE\_ADDRESS**

Sets the IEC bus address. The device address of K1404 can be changed by entering this command.

Please note: The device only responds to the new address after it has been switched off and on again!

Example:

```
IEEE_ADDRESS 12
IEEE_ADDRESS? --> +12
```

**LANGUAGE <Index>**

Sets the language of the device. The command sets the language of K1404.

Description of the parameter:

```
<Index> = 0: Language English
<Index> = 1: Language German
```

Example:

```
LANGUAGE 1
LANGUAGE? --> +1
```

**MEASURE <parameter>**

Sets the parameter for a measurement. This command is used to set all parameters of a measurement. A detailed parameter description is appended to the command description.

Example and explanation:

```
MEASURE 1,0,0>0,30,128,0,0,0,0,0,2,1,2,0,0,0
```

**MEASURE <parameter>**

(Continued)

Parameter setting of the measurement return loss: NT. The first three parameters (1,0,0) represent mode, group, measurement. All other parameters describe the specific settings for the relevant measurement.

The short form command MEASURE @, 3, 100 sets the 3rd parameter to 100. Before using the short form command, the parameters must have already been set at least once!

An incorrect command will be registered as 'Execution Error' in the status register ESR.

Before using the command START for the first time, the device parameters should have been set via MEASURE.

---

**MEASURE?**

Polls parameters for a measurement. The command causes the parameters of the measurement just set to be read out.

Example:

```
MEASURE? --->
1,0,0>0,30,128,0,0,0,0,0,2,+1.00000,+2.00000,0,
0,0
```

---

**PRINTOUT <Index>**

Outputs a hardcopy (via RS 232).

If the device is in remote control status, a printout can be triggered by this command.

Requirement:

Printer IBM or Epson is selected

Parameter description:

<Index> = 0: Printout horizontal

<Index> = 1: Printout 90° rotated

If, however Printer "Printout to PC" is selected (setting must be set beforehand via menu at the device), the index will have the following meanings:

<Index> = 0: Printout file is output in TIFF format

<Index> = 1: Printout file is output in a compressed format in order to be transferred to the PC via the SIEMENS hardcopy tool HC.exe.

---

---

**READ\_STATUS?**

Reads out status information from the status ring list. If the device is in remote control mode during a measurement, important events which also appear as messages in the small screen window are written into an internal status buffer in the form of coded numbers.

A bit is set accordingly in event register B (status available). The command `READ_STATUS?` can be entered to obtain the data from the device. The ASCII format is used for output.

Example:

Result after entering `READ_STATUS? --> +4, +106`

```
+4      Status buffer contains 4 status entries
+106   Last status entry
```

If there are no more status entries, +0 is output.

If a message is no longer relevant, the status can be cancelled. The status number is then increased by 1 for the IEC user. Simultaneously, the message window on the K1404 screen disappears.

Example:

```
STATUS +202 --> no INFO 1 was detected
and then:
STATUS +203 --> INFO 1 was detected (again)
```

Status information and their description:

**ANALOG1**

50	Par. Transmit Error Error in Host parameter transmission, module defective
52	Meas. Init Error Error in setting the module Analog1
54	Autorange Error Very unstable level at this frequency
56	CPU-Error, STOP Error in the transmission of the measuring panel data

---

---

**READ\_STATUS?****POWER MODULE****(Continued)**

150 PWR:Volt. set error  
Error in NT tests:  
In the procedure P\$set\$SpSpg\$UX\$2 the  
UK0 voltage cannot be set

152 PWR:Volt. swit. off  
Error in NT tests: UK0 load too high

156 PWR:internal error  
Error in NT tests: Power measurement: Ring buffer for  
measured values is full

158 PWR:Vers. mismatch  
HW version or type do not match the software

160 PWR: no LT connected  
Information in LT tests: no LT connected

161 Delete error message 160  
Information in LT tests: LT is connected

164 PWR: current too low  
Error in LT tests: LT supplies too little current

166 PWR: overload  
Information in NT tests: UK0 load too high  
UK0 voltage collapses

167 Delete error message 166  
Information: UK0 voltage is OK again

168 PWR: Init error  
Error: Comparator cannot be set

172 PWR: overload. P>8W  
Error in LT tests: Power consumption too high

**U INTERFACE**

200 Switchb. error  
Error in the setup of the measuring panel L31

202 Setup error  
Error in the setup of L330

210 Act. failed  
Activation failed

212 deactivated  
deactivated

214 Error on U  
Error on U interface: 15 s Timeout for activation

216 No MON Command  
No EOC command was output

222 Host Command?  
wrong command by Host

224 S0 not active  
S0 is not activated

226 L330 HW: 1.0!  
Measurement of clock accuracy by means of single  
pulses  
not possible with L330 hardware 1.0.



---

**READ\_STATUS?****Main-CPU****(Continued)**

350 No expected Board  
Board not expected

352 Read-Write failure  
Read-write failure between Main-CPU and boards

370 CPU:Missing L8/L80  
No analog board

372 CPU:Missing L110  
No power board

374 CPU:Missing L330 (1/2)  
No functional test board

378 CPU:Missing L30  
No jitter board

380 Board Reset  
Reset because of read / write error

382 CPU:Timeout-Start again  
Reset because of surpass of answering time

**JITTER**

302 JIT: NO MEASURING  
Upon Host command 'Start', i.e. in jitter measurement,  
if an error in the parameter transmission  
or in the setting has been previously detected

304 JIT: SET UP ERROR  
In functional tests, i.e. superimposed jitter,  
if an error in the parameter transmission  
or in the setting has been previously detected

**MAIN PROCESSOR (MAIN CPU)**

350 No expected Board/ Read-Write failure  
Board not expected

370 CPU:Missing L8/L80  
No analog board

372 CPU:Missing L110  
No power board

374 CPU:Missing L330 (1/2)  
No functional test board

378 CPU:Missing L30  
No jitter board

380 CPU: Board Reset  
Reset because of board transmission error

382 CPU: Timeout-Start again  
Reset because of surpass of answering time

384 Stop-Command terminated successfully  
(without message window)

---

**RESULT? 0**

Reads out the measured results: The command can be used to output the results of the last measurement or of a stored measurement. A binary data format is used for the results. More information about the measurement-specific result structures can be found in the sections following these command descriptions.

**Requirement:**

The device is in remote control status after STOP.

**Data format:**

```
ARBITRARY BLOCK PROGRAM DATA (ANSI/IEEE Std
488.2) <#> < XA>
<XB1> <XB2>... <XBn> <
Byte 1> ... <Byte n>
```

**Description:**

<#>	Preamble
<XA>	Length of length data in bytes (in ASCII code)
<XB1>..<XBn>	Number of data bytes (in ASCII code)
<Byte 1>..<Byte n>	Measurement results of measurement mode

**RESULT? 0****(Continued)**

Measuring data format starting with <Byte 1> with number, type and description:

1	BYTE	Result or Trace: Trace = 0; Result = 1
2	BYTE	IEC address (0 - 31)
3,4	WORD	Length of header in BYTES (here 15)
5,6	WORD	Length of measurement results in BYTES (Structure of measurement results depends on measurement mode)
7	BYTE	not used
8	BYTE	not used
9	BYTE	not used
10	BYTE	Internal format coding, e.g. 0: Graphical results 1: Numerical results 2: ASCII string
11	BYTE	Conformance byte Evaluation whether the measurement result lies within the limits of tolerance (depends on mode of measurement)
12...15	BYTE	RESERVE
16...32	BYTE	17 BYTE (ASCII) DATE/TIME (dd:mm:yy hh:mm:ss)
33.....	BYTE	Measurement results with length according to no. 5, 6 ****MEASUREMENT RESULTS****

## Data types

BYTE 8 Bit (MSB.....LSB)

WORD 16 BIT (LOW BYTE, HIGH BYTE)

**RESULT? 1**

Reads out the measurement results: The command can be used to output the results of the last measurement or of a stored measurement. Unlike the command `RESULT? 0` an additional 200 bytes are output for the menu parameters. The data format for these parameters is in ASCII code and corresponds to that of the command `MEASURE`.

Requirement:

The device is in remote control status after `STOP`.

Data format:

```
ARBITRARY BLOCK PROGRAM DATA (ANSI/IEEE Std
488.2) <#> <XA>
<XB1> <XB2>... <XBn>
<Byte 1>... <Byte n>
```

Description:

```
<#>    Preamble
<XA>   Length of length data in bytes (in ASCII code)
<XB1>..<XBn>   Number of data bytes (in ASCII code)
<Byte 1>..<Byte n> Measurement results of the relevant
                    mode of measurement
```

Measuring data format starting with < Byte 1 > with number, type and description:

1	BYTE	Result or Trace : Trace = 0 ; Result = 1
2	BYTE	IEC address (0 - 31)
3,4	WORD	Length of the header in bytes (here 15)
5,6	WORD	Length of measurement results per header in BYTES (Structure of measurement results depends on mode of measurement)
7	BYTE	not used
8	BYTE	not used
9	BYTE	not used
10	BYTE	Internal format coding, e.g. 0: Graphical results 1: Numerical results 2: ASCII string
11	BYTE	Conformance byte Evaluation whether measurement result are within the limits of tolerance (depends on measurement mode).

---

**RESULT? 1** 12..15 BYTE  
RESERVE

**(Continued)** 16..32 BYTE  
17 BYTE (in ASCII code) DATE/TIME  
(dd:mm:yy hh:mm:ss)

33..232 BYTE  
200 BYTE (in ASCII code)  
RELEVANT PARAMETERS OF MODE OF  
MEASUREMENT

233..... BYTE  
Measurement results with length according to no. 5,6  
\*\*\*\*\*MEASUREMENT RESULTS\*\*\*\*\*

Data types:

BYTE 8 Bit (MSB.....LSB)  
WORD 16 BIT (LOW BYTE, HIGH BYTE)

---

**RUNNING?** Polls device status. The request command reads the current status of the device during measurement.

Request result:

0 STOP status  
1 MEASURING status  
2 CALIBRATING status  
3 INITIALIZING status

---

**START** Starts the measurement. The command sets the device to the "MEASURING" status. Before this command is executed, the device parameters should be parameterized via MEASURE .

---

**STOP** Stops the measurement. The command sets the device to the "STOP" status.

---

**TIME hh,mm,ss** Sets the clock in K1404: The command sets the date of the real-time clock in K1404. The time can currently be read out in connection with the command RESULT? 1 only.

Parameter description:

hh hour  
mm minute  
ss second

Example:

TIME 15,46,0  
TIME? --> +15,+46,+0

**TRACE?**

Reads out the online measurement results. If the device is measuring under remote control, the measurement results are written to an internal trace buffer. The relevant bit is set in event register A (TAV = Trace Available). The data can be obtained from the device using this command. A binary data format is used for the results:

```
ARBITRARY BLOCK PROGRAM DATA
ANSI/IEEE Std 488.2) <#>
<XA> <XB1> <XB2>... <XBn>
<Byte 1> <Byte 2>.... <Byte n>
```

**Description:**

<#> Preamble  
 <XA> Length of length data in bytes (in ASCII code)  
 <XB1> .. <XBn>  
 Number of data bytes (in ASCII code)  
 <Byte 1>  
 Numb. of meas. results in the trace buffer  
 (in binary code)  
 <Byte 2> .. <Byte n>  
 Measurement results of the relevant measurement mode

Measuring data format starting with <Byte 2> with number, type, description:

1	BYTE	Result or Trace : Trace = 0 ; Result = 1
2	BYTE	IEC address (0 - 31)
3,4	WORD	Length of the header in BYTES (here 15)
5,6	WORD	Length of the measurement results per header in BYTES
		(Structure of the measurement result depends on mode of measurement)
7	BYTE	not used
8	BYTE	Number of data blocks for complete "meas. charact." (only for meas. of impedance, longitudinal unbalance)
9	BYTE	Current data block: (for impedance, longitudinal unbalance only)
10	BYTE	Internal format coding, e.g. 0: Graphical results 1: Numerical results 2: ASCII string

---

**TRACE?** 11 BYTE  
 Conformance byte: Evaluation whether the measurement  
 (Continued) ment result is within the limits of tolerance. The required conformance test depends on mode of measurement.

12....15 BYTE  
 RESERVE

16..... BYTE Measurement results according to no. 5,6  
 \*\*\*\*\*MEASUREMENT RESULTS\*\*\*\*\*

Data types:

BYTE 8 Bit (MSB.....LSB)  
 WORD 16 BIT (LOW BYTE, HIGH BYTE)

Almost every mode of measurement provides measurement results in different lengths and formats. The 15-byte header serves to inform the user about the characteristics of the measurement results. However, only those parameters which are useful will be set.

Significance of BYTE 1:

The evaluation of the number of measurement results in the trace buffer makes it possible for the user to monitor an 'ONLINE' application with respect to timing. If <BYTE1> increases, the device registers measuring data in the trace buffer faster than they are read out.

If there are no more measurement results in the trace buffer (<BYTE 1 = 0>), 0 is output.

---

**UPDATE <n>** Triggers an action. For an overview of the measurement-specific actions see section "Parameter descriptions and result structures" further below.

Description of the parameter:

n measurement-specific action

If the device is measuring under remote control, this command can be used to trigger an action.

---

## 9.4 Parameter descriptions and result structures

The following tables list for each measurement the parameters for the command `MEASURE` and for the result structures which can be polled via `RESULT`. An overview of the measurement-specific `UPDATE` actions is also included.

- Use the command `MEASURE` to set the measurement parameters.
- Use the command `RESULT` to poll the measurement results.
- Use the command `UPDATE` to trigger measurement-specific actions.

The following data types are used in the result structures:

BYTE     8 Bit (MSB.....LSB)  
WORD     16 BIT (LOW BYTE, HIGH BYTE)  
REAL     (floating-point arithmetics) = 32 BIT (single precision)  
          (BYTE1, BYTE2, BYTE3, BYTE4)

Sequence:

BYTE1 = FFFF|FFFF ;  
BYTE2 = FFFF|FFFF;  
BYTE3 = EFFF|FFFF;  
BYTE4 = SEEE|EEEE

F = Fraction bits  
E = Exponent bits  
S = Sign bit



Results, displayed in a graphic form, may be called up in numerical form with the `RESULT` key. Invalid results will display `f=0` and `Meßwert=0`. I.e. measurement of return in the frequency gap or measurements with an autorange error.



### 9.4.1 Measuring electrical characteristics

Measurements of the following electrical characteristics can be performed at the NT and LT:

Measurements of the electrical characteristics are combined in measurement group 0 (cf. parameter B).

Type of measurement	Mode	Interface
Return loss	at the NT at the LT	2B1Q 4B3T UP0
Longitudinal unbalance	at the NT at the LT	2B1Q 4B3T UP0
Longitudinal output voltage	at the NT at the LT	2B1Q 4B3T
Power spectral density	at the NT at the LT	2B1Q 4B3T
Total power	at the NT at the LT	2B1Q 4B3T
Noise voltage	at the NT at the LT	2B1Q 4B3T UP0

Measurements of the electrical characteristics are combined in measurement group 0 (cf. parameter B). The switch-over of the interface takes place globally via the command 'SET\_CODE' or via selection in the device menu.



The result structures of the electrical characteristics are identical in both NT and LT measurements.

### 9.4.1.1 Return loss

Command: MEASURE [A], [B], [C]>[1], [2], ..., [14]

No.	Description	Comments
A	1 = NT mode	0 = LT mode
B	0 = Electrical tests	
C	0 = Measurement RETURN LOSS	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	
2	Load current (in steps of 1 mA) Range: 0...100 (0...100mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1 (applies to LT mode)
4	Mode 0: Low noise 1: Low distortion	
5	Device under test 0: Is passive 1: Sends single pulse	
6	Default 0	Reserve
7	Termination: 0: 135 Ω 1: 150 Ω	
8	Bandwidth: 0: 25 Hz 1: 2 kHz	Only effective if par. no.5 = 0
9	Frequency range 0: Edit 1: Last Edit 2: 1 KHz 200 kHz	
10	Lower frequency Fmin (kHz) Range: 1.000 to 1000.000 (1 kHz...1000 kHz)	Only effective if par. no.9 = 0 1
11	Upper frequency Fmax (kHz) Range: 1.000 to 1000.000 (1 kHz...1000 kHz)	Only effective if par. no.9 = 0 1
12	Tol. mask 0: Off 1: Mask on	Only effective if par. no.9 = 2
13	Time interruptor (frequency gap) 0: On 1: Off	Only effective if par no.5 = 0
14	Default 0	Reserve

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement, 10 times 27 measured value pairs for one measurement characteristic
Type of measured values	Graphical measurement characteristic (internal format code 0)
Number of bytes (for meas. values)	2160
Number of measured value pairs	270
Sequence	$X_1, Y_1, X_2, Y_2, \dots, X_{270}, Y_{270}$
Format (all measured values)	REAL, 4 BYTE
Unit of measurement	X=frequency (kHz) , Y=return loss (dB)

### 9.4.1.2 Longitudinal unbalance

Command: MEASURE [A], [B], [C]>[1], [2], ..., [14]

No.	Description	Comments
A	1 = NT mode	0 = LT mode
B	0 = Electrical tests	
C	1 = Measurement LONGITUDINAL UNBALANCE	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1 (applies to LT mode)
4	Mode 0: Low noise 1: Low distortion	Only effective if par. no.5= 0
5	Device under test 0: Is passive 1: Sends single pulses	
6	DEFAULT: 0	RESERVE
7	Termination: 0: 135 Ω 1: 150 Ω	
8	Bandwidth: 0: 25 Hz 1 2 kHz	Only effective if par. no.5= 0
9	Frequency range 0: Edit 1: Last Edit 2: 0.5 kHz - 200 kHz 3: 1,0 kHz - 1000,0 kHz	
10	Lower frequency Fmin (kHz) Range: 1,000 to 1000,000 (1 kHz...1000 kHz)	Only effective if par. no.9 = 0 1
11	Upper frequency Fmax (kHz) Range:1,000 to 1000,000 (1 kHz...1000 kHz)	Only effective if par. no.6 = 0 1
12	Tol. mask 0: Off 1: Mask ETSI on 2: Mask ANSI on	Only effective if par. no.9 = 2
13	Default 0	Reserve
14	Default 0	Reserve

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement, 10 times 27 measured value pairs for one measurement characteristic
Type of measured values	Graphical measurement characteristic (internal format code 0)
Number of bytes (for meas. values)	2160
Number of measured value pairs	270
Sequence	X <sub>1</sub> ,Y <sub>1</sub> ,X <sub>2</sub> ,Y <sub>2</sub> .....X <sub>270</sub> ,Y <sub>270</sub>
Format (all measured values)	REAL, 4 BYTE
Unit of measurement	X=frequency (kHz) , Y=longitudinal unbalance (dB)

### 9.4.1.3 Longitudinal output voltage

Command: MEASURE [A],[B],[C]>[1],[2],..., [11]

No.	Description	Comments
A	1 = NT mode	0 = LT mode
B	0 = Electrical tests	
C	2 = Measurement LONGITUDINAL OUTPUT VOLTAGE	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1 (applies to LT mode)
4	Termination: 0: 135 Ω 1: 150 Ω	
5	Frequency range 0: Edit 1: Last Edit 2: 2.5 kHz - 300 kHz 3: 2.5 kHz - 1 MHz	
6	Lower frequency Fmin (kHz) Range: 2,500 to 1000,000 (1 kHz...1000 kHz)	Only effective if par. no.5 = 0 /1
7	Upper frequency Fmax (kHz) Range: 21,000 to 1000,000 (1 kHz...1000 kHz)	Only effective if par. no.5 = 0 /1
8	DEFAULT: 0	RESERVE
9	Tol. mask 0: Off 1: Mask on	Only effective if par. no.5 = 2
10	Control of NT by K1404 0: Off 1: INSERTION LOSS	= 1 only permissible, if par 1 = 0
11	Default 0	Reserve

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement, 10 times 27 measured value pairs for one measurement characteristic
Type of measured values	Graphical measurement characteristic (internal format code 0)
Number of bytes (for meas. values)	2160
Number of measured value pairs	270
Sequence	X <sub>1</sub> ,Y <sub>1</sub> ,X <sub>2</sub> ,Y <sub>2</sub> .....X <sub>270</sub> ,Y <sub>270</sub>
Format (all measured values)	REAL, 4 BYTE
Unit of measurement	X=frequency (kHz) , Y=longitudinal output voltage (dBV)

#### 9.4.1.4 Power spectral density

Command: MEASURE [A], [B], [C]>[1], [2], ..., [11]

No.	Description	Comments
A	1 = NT- Mode	0 = LT mode
B	0 = Electrical tests	
C	3 = Measurement POWER SPECTRAL DENSITY	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1 (applies to LT mode)
4	Default 0	Reserve
5	Frequency range: 0: Edit 1: Last Edit 2: 2.5 kHz 1 MHz (Bandwidth: 2 kHz)	
6	Lower frequency Fmin (kHz) Range: 2,500 to 1000,000 (2,5...1000 kHz)	Only effective if par. no.5 = 0 1
7	Upper frequency Fmax (kHz) Range: 2,5000 to 1000,000 (2,5...1000 kHz)	Only effective if par. no.5 = 0 1
8	Termination: 0: 135 Ω 1: 150 Ω 2: ∞ (10 kΩ)	
9	Tol. mask 0: Off 1: Mask on	
10	Control of the NT by K1404 0: Activation 1: External 2: INSERTION LOSS	= 2 only permissible, if par 1 = 0
11	Default 0	Reserve



**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement, 10 times 27 measured value pairs for one measurement characteristic
Type of measured values	Graphical measurement characteristic (internal format code 0)
Number of bytes (for meas. values)	2160
Number of measured value pairs	270
Sequence	$X_1, Y_1, X_2, Y_2, \dots, X_{270}, Y_{270}$
Format (all measured values)	REAL, 4 BYTE
Unit of measurement	X=frequency (kHz) , Y =power level (dBm/Hz) or X=frequency (kHz) , Y =noise voltage (mV)

### 9.4.1.5 Total power

Command: MEASURE [A], [B], [C]>[1], [2], ..., [7]

No.	Description	Comments
A	1 = NT mode	0 = LT mode
B	0 = Electrical tests	
C	4 = Measurement TOTAL POWER	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1 (applies to LT mode)
4	Termination: 0: 135 Ω 1: 150 Ω 2: ∞ (10 kΩ)	
5	Control of the NT by K1404 0: Activation 1: External 2: INSERTION LOSS	= 2 only permissible, if par 1 = 0
6	Default 0	Reserve
7	Default 0	Reserve

### Result structure

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Status information + numerical single values (internal format code 1)
Number of bytes	15
Result format	see below "Detailed results format"
Conformance test	No

### Detailed results format

Element	Description	Value
0	Byte = Status mask  Description:  MSB...LSB XXXX00XX = current measured value XXXX10XX = measured value < limit XXXX01XX = measured value > limit	
1	Byte = Reserve 1	
2	Byte = Reserve 2	
3	REAL = Y1 Size: df/F Unit of measurement: ppm	
4	REAL = Reserve 3	
5	REAL = Reserve 4	

### 9.4.1.6 Noise voltage

Command: MEASURE [A], [B], [C] > [1], [2], ..., [11]

No.	Description	Comments
A	1 = NT- Mode	0 = LT mode
B	0 = Electrical tests	
C	5 = Measurement NOISE VOLTAGE	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1 (applies to LT mode)
4	Default 0	Reserve
5	Frequency range: 0: Edit 1: Last Edit 2: 2.5 kHz...540 kHz (linear) 3: 500 kHz...1 MHz (linear) 4: 200 Hz...2.5 kHz (linear)	
6	Lower frequency Fmin (kHz) Range: 2,500 to 1000,000 (2,5...1000 kHz)	Only effective if par. no.5 = 0 1
7	Upper frequency Fmax (kHz) Range: 2,5000 to 1000,000 (2,5...1000 kHz)	Only effective if par. no.5 = 0 1
8	Termination: 0: 135 Ω 1: 150 Ω 2: ∞ (10 kΩ)	
9	Tol. mask 0: Off 1: Mask on	
10	Control of NT by K1404 0: Deactivation 1: External 2: QUIET MODE	= 2 only permissible, if par 1 = 0
11	Default 0	Reserve

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement, 10 times 27 measured value pairs for one measurement characteristic
Type of measured values	Graphical measurement characteristic (internal format code 0)
Number of bytes (for meas. values)	2160
Number of measured value pairs	270
Sequence	$X_1, Y_1, X_2, Y_2, \dots, X_{270}, Y_{270}$
Format (all measured values)	REAL, 4 BYTE
Unit of measurement	X =frequency (kHz) , Y =noise voltage (mV)

### 9.4.2 Power tests

The following power feeding tests (measurement group 2, cf. parameter B) can be carried out on the NT and LT:

Type of measurement	Mode	Interface
Power consumption	at the NT	2B1Q 4B3T UP0
Power condition	at the LT	2B1Q 4B3T UP0
Switch-on test	at the NT	2B1Q 4B3T UP0

The switch-over of the interface takes place globally with the command 'SET\_CODE' or via selection in the device menu.

### 9.4.2.1 Power consumption (NT only)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [11]

No.	Description	Comments
A	1 = TE mode	
B	2 = Power feeding tests	
C	1 = Measurement POWER CONSUMPTION	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	not effective
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	not effective
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	not effective
4	Control: 0: Deactivation 1: Activation	
5	Mode NT: 0: Normal 1: Restricted	
6	Voltage measurement: 0: Internal 1: External	
7	Line resistor: 0: 600 Ω 1: 1000 Ω 2: 1400 Ω	
8	Measuring range: 0: 0..50 mA 1: 0..10 mA 2: 0..2000 µA 3: 0..500 µA	
9	Voltage (in steps of ¼ volt) Range: 0...480 (0...120 V)	
10	Default 0	Reserve
11	Default 0	Reserve



Use the command UPDATE 1 to set new MIN/MAX values.

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Structure of measured values	Numerical single measured values (internal format coding 1)
Number of bytes (for measured values)	28
Number of measured values	7
Sequence	$Y_1, Y_2, Y_3, Y_4, Y_5, Y_6, Y_7$
Description	$Y_1 = P_{avg}, Y_2 = P_{min}, Y_3 = P_{max}, Y_4 = I_{avg},$ $Y_5 = I_{min}, Y_6 = I_{max}, Y_7 = U$
Format	REAL, 4 BYTE
Unit of measurement	$Y_1 = (W), Y_2 = (W), Y_3 = (W), Y_4 = (A), Y_5 = (A), Y_6 = (A),$ $Y_7 = (V)$
Conformance test	No



### 9.4.2.2 Switch-on test

Command: MEASURE [A], [B], [C] > [1], [2], ..., [11]

No.	Description	Comments
A	1 = NT mode	
B	2 = Power feeding tests	
C	1 = Measurement SWITCH-ON TEST	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	not effective
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	not effective
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	not effective
4	Control: 0: Deactivation 1: Activation	
5	Mode NT: 0: Normal 1: Restricted	
6	Measuring range 0: 0..100 mA 1: 0..50 mA 2: 0..10 mA 3: 0..2000 µA 4: 0..500 µA	
7	Line resistor: 0: None 1: 600 Ω 2: 1000 Ω 3: 1400 Ω	
8	Measure time: 0: 500 ms 1: 1 s 2: 2 s 3: 4 s 4: 8 s 5: 16 s 6: 32 s 7: 64 s	
9	Voltage (in in steps of ¼ volt) Range: 0...480 (0...120 V)	
10	OFF STATE TEST: 0: Off 1: On	
11	Default 0	Reserve

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Single measurement
Structure of measured values	Graphical measurement characteristic
Number of bytes (for measured values)	1000
Number of measured values	250
Sequence	X <sub>1</sub> , Y <sub>1</sub> , Y <sub>2</sub> , Y <sub>2</sub> .....X <sub>250</sub> , Y <sub>250</sub>
Format	REAL, 4 BYTE
Unit of measurement	X= time t (S) Y= current i (A)
Conformance test	No

### 9.4.2.3 Power condition (LT only)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [13]

No.	Description	Comments
A	0 = Measurements on LT	
B	2 = Power feeding tests	
C	0 = Measurement POWER CONDITION	
1	Load/Power: 0: Off 1: Normal 2: Normal with RL 3: External	not effective
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	not effective
3	Power feeding voltage (in steps of 1/4 volt) Range: 40...480 (10...120 V)	not effective
4	Control: 0: Activation 1: Deactivation	
5	DEFAULT 0	RESERVE
6	Minimum load current 0 ... 100 mA in steps of 500 $\mu$ A Range: 1...200	
7	Maximum load current 1 ... 100 mA in steps of 500 $\mu$ A Range: 2...200	
8	Change of load current 500 $\mu$ A ... 10 mA in steps of 500 $\mu$ A Range: 1...20	
9	Duration of load current 100 ms ... 10 s in steps of 100 m Range: 1...100	
10	DEFAULT 0	RESERVE
11	DEFAULT 0	RESERVE
12	DEFAULT 0	RESERVE
13	DEFAULT 0	RESERVE



Use the command UPDATE 1 to set new MIN/MAX values.

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Structure of measured values	Numerical single measured values (internal format coding 7)
Number of bytes (for measured values)	50
Number of measured values	6
Sequence	see below "Detailed results format"
Format	REAL, 4 BYTE
Conformance test	nein

**Detailed results format**

Element	Description	Value
0	Control byte	0: byte 2-13 is updated 1: bytes 14-25 are updated
1	Number of cycles (0 ... 255)	
2 ... 5	Current value of power (output every second)	
6 ... 9	Current value of current (output every second)	
10 ... 13	Current value of voltage (output every second)	
14 ... 17	Maximum power per cycle (output with new cycle)	
18 ... 21	Current value of current per cycle (output with new cycle)	
22 ... 25	Current value of voltage per cycle (output with new cycle)	
26 ... 49	Reserve	

### 9.4.3 Functional tests

Within the framework of the functional tests, the following measurements can be carried out on the NT and LT:

Type of measurement	Mode	Interface
FREQUENCY SHIFTING	at the NT at the LT	2B1Q 4B3T UP0
SHORT-TIME INTERRUPTION	at the NT at the LT	2B1Q 4B3T UP0
CLOCK ACCURACY	at the NT at the LT	2B1Q 4B3T UP0

Measurements of functional tests are combined in measurement group 1 (cf. parameter B).

The change-over of the interface takes place globally with the command 'SET\_CODE' or via selection in the device menu.

### 9.4.3.1 Frequency shifting (NT) (line code 2B1Q)

Command: MEASURE [A], [B], [C] > [1], [2], ..., [22]



Use the command 'SET\_CODE 1' to switch over to the line code 2B1Q.

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	0 = Measurement FREQUENCY SHIFTING	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 1 3: Single pulses 4: Deactivation 5: Deactivation + Activation 6: U activation only	4: Basic setting
7	Special functions: 0: LOOP2 2B+D 1: LOOP2 B1 2: LOOP2 B2 3: CORRUPT CRC 4: REQUEST CORRUPT CRC 5: NOTIFY OF CORRUPT CRC 6: RETURN TO NORMAL	All special functions are only effective if par. no. 6 = 0;1;6  6: Basic setting
8	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting

(Continued)

9	Clock: 0: Internal 1: External (2.048 MHz) 2: External (1.536 MHz) 3: Jittered	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: MOS	1: Basic setting
11	Frequency shifting: 0: +0 ppm 1: +1 ppm 2: +2 ppm etc. 127: +127 ppm 128: -128 ppm 129: -127 ppm 130: -126 ppm 131: -125 ppm etc. 255: -1 ppm	0: Basic setting
12	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	Only effective if par. no. 5 = 0 Only effective if par. no. 5 = 0 Only effective if par. no. 5 = 0 Only effective if par. no. 5 = 0 4: Basic setting  <b>Rx internal:</b> internal analysis of data coming from U. <b>Rx external:</b> transmit data coming from U to socket for external analysis. <b>Tx internal:</b> transmit data generated inter- nally to U. <b>Tx external:</b> transmit external data to U.

(Continued)

No.	Description	Comments
13	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	0: Basic setting
14	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
15	Bit error measurement: 0: Off 1: On	0: Basic setting
16	Jitter Deviat. Range 0: 0,35 UIss 1: 0,08 UIss	Only effective if par. no. 9 = 3 0: Basic setting
17	Jitter deviation: 4: 0,008 / 0,0020 UIss 5: 0,010 / 0,0025 UIss 6: 0,012 / 0,0030 UIss etc. 150: 0,300 / 0,0750 UIss 170: 0,350 / 0,0875 UIss	Only effective if par. no. 9 = 3 4: Basic setting Conversion: par. no.16 = 0 Jitter Deviat.= $(\text{value} * 2) / 1000$ par. no.16 = 1 Jitter Deviat.= $(\text{value} / 2) / 1000$
18	Jitter frequency: 0: 0,0 Hz 1: 0,1 Hz 2: 0,2 Hz 10: 1,0 Hz 100: 10 Hz 1000: 100 Hz 1999: 199,9 Hz 10000: 1000 Hz 100000: 10000 Hz etc. 200000: 20000 Hz	Only effective if par. no. 9 = 3 0: Basic setting  If par. no. 16 = 0: only values from 1 (0.1 Hz) to 20000 (2 kHz) per- missible.
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve



The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
f <--	Update 3
f -->	Update 4
Single bit error	Update 5
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

### Result structure frequency shifting (NT) (line code 2B1Q)

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	442
Results format	see below "Detailed results format"
Conformance test	No comment

Detailed results format

Element	Description	Value								
0	Byte = Conformity of measurement									
1	Byte = Trace line is updated	= 1 updated								
2	Byte = Currently set ppm value									
3	Byte = Interruption time in ms if mode of measurement Short Time Interruption has been selected									
4	Byte = Information on availability of measured values, see table									
5	Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>act</td><td>usr1</td><td>usr2</td><td>ps1</td> </tr> </table> LSB	X	X	X	X	act	usr1	usr2	ps1	
X	X	X	X	act	usr1	usr2	ps1			
6	Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>usr3</td><td>febe</td><td>ps2</td><td>ntm</td><td>cso</td><td>usr4</td><td>sai</td><td>usr5</td> </tr> </table> LSB	usr3	febe	ps2	ntm	cso	usr4	sai	usr5	
usr3	febe	ps2	ntm	cso	usr4	sai	usr5			
7	Byte = Reserve 4									
8	Byte = Reserve 5									
9	Byte = Reserve 6									
10	Byte = Reserve 7									
11	Byte = Reserve 8									
12	Byte = Reserve 9									
13	Byte = Reserve 10									
14,15	Word = Near and Block Error Counter									
16,17	Word = Far and Block Error									
18 ... 21	Real = Result measured time									
22 ... 25	Real = Result bit error ASIC24 U side									
26 ... 29	Real = Result error rate ASIC24 U side									
30 ... 33	Real = Result bit error ASIC24 S side									
34 ... 37	Real = Result error rate ASIC24 S side									
38 ... 437	Byte = ASCII text for trace line									

Given measured values

Bit 0	Trace line always valid fixed = 1
Bit 1	Bit error U valid = 1; invalid = 0
Bit 2	Bit error S valid = 1; invalid = 0
Bit 3	NEB / FEB always valid fixed = 1
Bit 4	ppm value always valid fixed = 1
Bit 5	Interruption time, if mode of measurement Short Time Interruption has been selected, then = 1
Bit 6	Bit error rate measured via B channel 64 kBit = 0; Bit error rate measured via B channel 128 kBit = 0;
Bit 7	Not used

### 9.4.3.2 Frequency shifting (LT) (line code 2B1Q)

Befehl: MEASURE [A], [B], [C] > [1], [2], ..., [25]



Use the command 'SET\_CODE 1' to switch over to the line code 2B1Q.

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	0 = Measurement FRQUENCY SHIFTING	
1	Load: 0: Off 1: Normal 2: <b>not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control:  1: Activation downstream 2: Activation upstream 3: Activation Loop 3 4: Single pulses	1: Basic setting 2 to 4 only effective if par. no.5 = 0
7	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting
8	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: MOS	1: Basic setting

(Continued)

No.	Description	Comments
9	Frequency shifting: 0: +0 ppm 1: +1 ppm 2: +2 ppm etc. 127: +127 ppm 128: -128 ppm 129: -127 ppm 130: -126 ppm 131: -125 ppm etc. 255: -1 ppm	0: Basic setting
10	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10 B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
11	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	2: Basic setting
12	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
13	Bit error measurement: 0: off 1: on	0: Basic setting 1: only effective if par.5 = 0
14	Default 0	Reserve

(Continued)

No.	Description	Comments
15	Default 0	Reserve
16	Default 0	Reserve
17	Default 0	Reserve
18	Default 0	Reserve
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
f <--	Update 3
f -->	Update 4
Single bit error	Update 5
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

**Result structure frequency shifting (LT) (line code 2B1Q)**



The result structures are identical with that at the NT except for the following exceptions:

5	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>act</td><td>usr1</td><td>usr2</td><td>dea</td> </tr> </table> LSB	X	X	X	X	act	usr1	usr2	dea	
X	X	X	X	act	usr1	usr2	dea			
6	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>usr3</td><td>febe</td><td>usr4</td><td>usr5</td><td>usr6</td><td>usr7</td><td>uoa</td><td>aib</td> </tr> </table> LSB	usr3	febe	usr4	usr5	usr6	usr7	uoa	aib	
usr3	febe	usr4	usr5	usr6	usr7	uoa	aib			

### 9.4.3.3 Frequency shifting (NT) (line code 4B3T)

Command: MEASURE [A], [B], [C] > [1], [2], ..., [29]



Use the command 'SET\_CODE 0' to switch over to the line code 4B3T.

#### Parameter deviations for 4B3T

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	1 = Measurement FREQUENCY SHIFTING	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 1 3: Activation Loop 2 4: Activation Loop 4 5: Send single pulses 6: Deactivate 7: Deactivate + Activate	6: Grundeinstellung
7	Default 0	Reserve
8	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting  only if clock <> 2
9	Clock: 0: Internal 1: External (2,048MHz) 2: External (1,536MHz) 3: Jittered	0: Basic setting

(Continued)

No.	Description	Comments
10	Trigger: 0: No Trigger 1: U frame 2: U clock 3: CIC	1: Basic setting
11	Frequency shifting: 0: +0 ppm 1: +1 ppm 2: +2 ppm etc. 127: +127 ppm 128: -128 ppm 129: -127 ppm 130: -126 ppm 131: -125 ppm etc. 255: -1 ppm	0: Basic setting
12	Data Control: 0: B1+B2 Rx intern / Tx intern 1: B1+B2 Rx extern / Tx intern 2: B1+B2 Rx intern / Tx extern 3: B1+B2 Rx extern / Tx extern 4: B1 Rx intern / Tx intern 5: B1 Rx extern / Tx intern 6: B1 Rx intern / Tx extern 7: B1 Rx extern / Tx extern 8: B2 Rx intern / Tx intern 9: B2 Rx extern / Tx intern 10: B2 Rx intern / Tx extern 11: B2 Rx extern / Tx extern 12: MON+B* Rx extern 13: MON Rx extern 14: B * Rx extern	<ul style="list-style-type: none"> <li>•only effective if</li> <li>•par. no. 5 = 0</li> <li>•</li> <li>•</li> </ul> 4: Basic setting  <b>Rx internal:</b> internal analysis of data coming from U. <b>Rx external:</b> transmit data coming from U to socket for external analysis. <b>Tx internal:</b> transmit data generated internally to U. <b>Tx external:</b> transmit external data to U.
13	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	0: Basic setting
14	Error: 0: no error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting



(Continued)

No.	Description	Comments
15	Bit error measurement: 0: off 1: on	0: Basic setting
16	Jitter Deviat. Range: 0: 0,35 UIss 1: 0,08 UIss	Only effective if par. no. 9 = 3! 0: Basic setting
17	Jitter device: 4: 0,008 / 0,0020 UIss 5: 0,010 / 0,0025 UIss 6: 0,012 / 0,0030 UIss etc. 150: 0,300 / 0,0750 UIss 170: 0,350 / 0,0875 UIss	Only effective if par. no. 9 = 3 4: Basic setting Conversion: par. no.16 = 0 Jitter Deviat.=(value *2)/1000 par. no.16 = 1 Jitter Deviat.=(value /2)/1000
18	Jitter frequency: 0: 0,0 Hz 1: 0,1 Hz 2: 0,2 Hz 10: 1,0 Hz 100: 10 Hz 1000: 100 Hz 1999: 199,9 Hz 10000: 1000 Hz 100000: 10000 Hz etc. 200000: 20000 Hz	Only effective if par. no. 9 = 3 0: Basic setting  If par. no. 16 = 0: only values from 1 (0,1Hz) to 20000 (2kHz) per- missible.
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve
26	Default 0	Reserve
27	Default 0	Reserve
28	Default 0	Reserve
29	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
f <--	Update 3
f -->	Update 4
Single bit error	Update 5
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

### Result structure frequency shifting (line code 4B3T)

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comments

## Detailed results format

Element	Description	Value
0	Byte = Conformity of measurement	
1	Byte = Trace line is updated	= 1 updated
2	Byte = Currently set ppm value	
3	Byte = Interruption time in ms if measurement Short time interruption was selected	
4	Byte = Information on availability of measured values see. table: 9.3	
5	Byte = Reserve 2	
6	Byte = Reserve 3	
7	Byte = Reserve 4	
8	Byte = Reserve 5	
9	Byte = Reserve 6	
10	Byte = Reserve 7	
11	Byte = Reserve 8	
12	Byte = Reserve 9	
13	Byte = Reserve 10	
14,15	Word = RDS-Counter	
16,17	Word = Reserve 11	
18 ... 21	Real = Result measured time	
22 ... 25	Real = Result bit error ASIC24 U side	
26 ... 29	Real = Result error rate ASIC24 U side	
30 ... 33	Real = Result bit error ASIC24 S side	
34 ... 37	Real = Result error rate ASIC24 S side	
38 ... 437	Byte = ASCII text for trace line	

Given measured values

Bit 0	Trace line always valid steady = 1
Bit 1	Bit error U valid = 1; invalid = 0
Bit 2	Bit error S valid = 1; invalid = 0
Bit 3	RDS always valid steady = 1
Bit 4	ppm value always valid steady = 1
Bit 5	Interruption time, if type of measurement short-time interruption was selected, then = 1
Bit 6	Bit error rate measured via a B channel 64 kBit = 0; Bit error rate measured via a B channel 128 kBit = 0;
Bit 7	not used

### 9.4.3.4 Frequency shifting (LT) (line code 4B3T)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [22]



Use the command 'SET\_CODE 0' to switch over to the line code 4B3T.

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	1 = Measurement FREQUENCY SHIFTING	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 3 3: Single pulses	0: Basic setting 0 to 3 only effective if par. no.5 = 0
7	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting
8	Trigger: 0: No Trigger 1: U frame 2: U clock 3: CIC	1: Basic setting

(Continued)

No.	Description	Comments
9	Frequency shifting: 0: +0 ppm 1: +1 ppm 2: +2 ppm etc. 127: +127 ppm 128: -128 ppm 129: -127 ppm 130: -126 ppm 131: -125 ppm etc. 255: -1 ppm	0: Basic setting
10	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external	4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
11	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	2: Basic setting
12	Error: 0: no error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
13	Bit error measurement: 0: off 1: on	0: Basic setting
14	Default 0	Reserve

(Continued)

No.	Description	Comments
15	Default 0	Reserve
16	Default 0	Reserve
17	Default 0	Reserve
18	Default 0	Reserve
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
f <--	Update 3
f -->	Update 4
Single bit error	Update 5
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.



The result structure is identical to the one at the NT (see above).

### 9.4.3.5 Frequency shifting (NT) (line code UP0)

Command: MEASURE [A],[B],[C]>[1],[2],...,[29]



Use the command 'SET\_CODE 2' to switch over to the line code UP0.

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	0 = Measurement FREQUENCY SHIFTING	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 100 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 1 3: Activation Loop 2 4: Send continuous pulses 5: Send single pulses 6: Deactivate 7: Deactivate + Activate	4: Basic setting
7	Default 0	Reserve
8	Connection to device under test: 0: Direct 1: External line 2: Externe Leitung with power feeding	0: Basic setting
9	Clock: 0: Internal 1: External (2,048MHz) 2: External (1,536MHz)	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC	1: Basic setting



(Continued)

No.	Description	Comments
11	Frequency shifting: 0: +0 ppm 1: +1 ppm 2: +2 ppm etc. 127: +127 ppm 128: -128 ppm 129: -127 ppm 130: -126 ppm 131: -125 ppm etc. 255: -1 ppm	0: Basic setting
12	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	Only effective if par. no. 5 = 0 Only effective if par. no. 5 = 0 Only effective if par. no. 5 = 0 Only effective if par. no. 5 = 0 4: Basic setting  <b>Rx internal:</b> internal analysis of data coming from U. <b>Rx external:</b> transmit data coming from U to socket for external analysis. <b>Tx internal:</b> transmit data generated inter- nally to U. <b>Tx external:</b> transmit external data to U.
13	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	0: Basic setting
14	Error: 0: no error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting

(Continued)

No.	Description	Comments
15	Bit error measurement: 0: Off 1: On	0: Basic setting
16	Jitter deviation range Default 0	
17	Jitter deviation: Default 0	
18	Jitter frequency: Default 0	
19	Default 0	
20	Default 0	
21	Default 0	
22	Default 0	
23	Default 0	
24	Default 0	
25	Default 0	
26	Default 0	
27	Default 0	Reserve
28	Default 0	Reserve
29	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
f <--	Update 3
f -->	Update 4
Single bit error	Update 5
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

**Result structure frequency shifting (NT) (line code UP0)**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	442
Results format	see below "Detailed results format"
Conformance test	No comments

## Detailed results format

Element	Description	Value
0	Byte = Conformity of measurement	
1	Byte = Trace line is updated	= 1 updated
2	Byte = Currently set ppm value	
3	Byte = Interruption time in ms if measurement Short time interruption was selected	
4	Byte = Information on availability of measured values see table	
5	Byte = Reserve 2	
6	Byte = Reserve 3	
7	Byte = Reserve 4	
8	Byte = Reserve 5	
9	Byte = Reserve 6	
10	Byte = Reserve 7	
11	Byte = Reserve 8	
12	Byte = Reserve 9	
13	Byte = Reserve 10	
14,15	Word = RDS-Counter	
16,17	Word = Reserve 11	
18 ... 21	Real = Result measured time	
22 ... 25	Real = Result bit error ASIC24 U side	
26 ... 29	Real = Result error rate ASIC24 U side	
30 ... 33	Real = Result bit error ASIC24 S side	
34 ... 37	Real = Result error rate ASIC24 S side	
38 ... 437	Byte = ASCII text for trace line	

Given measured values

Bit 0	Trace line always valid steady = 1
Bit 1	Bit error U valid = 1; invalid = 0
Bit 2	Bit error S valid = 1; invalid = 0
Bit 3	RDS always valid steady = 1
Bit 4	ppm value always valid steady = 1
Bit 5	Interruption time, if type of measurement short-time interruption was selected, then = 1
Bit 6	Bit error rate measured via a B channel 64 kBit = 0; Bit error rate measured via a B channel 128 kBit = 0;
Bit 7	not used

### 9.4.3.6 Frequency shifting (LT) (line code UP0)

Command: MEASURE [A], [B], [C] > [1], [2], ..., [25]



Use the command 'SET\_CODE 2' to switch over to the line code 4B3T.

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	0 = Measurement FREQUENCY SHIFTING	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 100 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 3 3: Single pulses 4: Continuous pulses	1: Basic setting 2 to 4 only effective if par. no.5 = 0
7	Connection to device under test: 0: Direct 1: External line 2: External line with power feeding	0: Basic setting
8	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC	1: Basic setting

(Continued)

No.	Description	Comments
9	Frequency shifting: 0: +0 ppm 1: +1 ppm 2: +2 ppm etc. 127: +127 ppm 128: -128 ppm 129: -127 ppm 130: -126 ppm 131: -125 ppm etc. 255: -1 ppm	0: Basic setting
10	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10 B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	4: Basic setting  <b>Rx internal:</b> internal analysis of data coming from U. <b>Rx external:</b> transmit data coming from U to socket for external analysis. <b>Tx internal:</b> transmit data generated internally to U. <b>Tx external:</b> transmit external data to U.
11	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	2: Basic setting
12	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
13	Bit error measurement: 0: Off 1: On	0: Basic setting
14	Default 0	

(Continued)

No.	Description	Comments
15	Default 0	
16	Default 0	
17	Default 0	
18	Default 0	
19	Default 0	
20	Default 0	
21	Default 0	
22	Default 0	Reserve
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
f <--	Update 3
f -->	Update 4
Single bit error	Update 5
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.



The result structure is identical to the one at the NT (see above).

### 9.4.3.7 Short time interruption (NT) (line code 2B1Q)

Command: MEASURE [A], [B], [C] > [1], [2], ..., [22]

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	1 = Measurement SHORT TIME INTERRUPTION	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	S0 interface: 0: Not active (off) 1: Active (TE function)	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 1 3: Single pulses 4: Deactivation 5: Deactivation + Activation 6: U only Activation	4: Basic setting
7	Special functions: 0: LOOP2 2B+D 1: LOOP2 B1 2: LOOP2 B2 3: CORRUPT CRC 4: REQUEST CORRUPT CRC 5: NOTIFY OF CORRUPT CRC 6: RETURN TO NORMAL 7: HOLD-CMD	All special functions are only effective if par. no. 6 = 0;1;6  6: Basic setting
8	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting
9	Clock: 0: Internal 1: External (2,048MHz) 2: External (1,536MHz) 3: Jittered	0: Basic setting



10	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: MOS 5: Interruption	1: Basic setting
11	Interruption time 20: 20 ms 30: 30 ms 40: 40 ms etc. 250: 250ms	20: Basic setting
12	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10 B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	•only effective if •par. no. 5 = 0 • • 4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
13	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	0: Basic setting
14	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting

(Continued)

No.	Description	Comments
15	Bit error measurement: 0: Off 1: On	0: Basic setting
16	Jitter Deviat. Range: 0: 0,35 UIss 1: 0,08 UIss	Only effective if par. no. 9 = 3! 0: Basic setting
17	Jitter deviation: 4: 0,008 / 0,0020 UIss 5: 0,010 / 0,0025 UIss 6: 0,012 / 0,0030 UIss etc. 150: 0,300 / 0,0750 UIss 170: 0,350 / 0,0875 UIss	Only effective if par. no. 9 = 3 4: Basic setting Conversion: par. no.16 = 0 Jitter Deviat.=(value *2)/1000 par. no.16 = 1 Jitter Deviat.=(value /2)/1000
18	Jitter frequency: 0: 0,0 Hz 1: 0,1 Hz 2: 0,2 Hz 10: 1,0 Hz 100: 10 Hz 1000: 100 Hz 1999: 199,9 Hz 10000: 1000 Hz 100000: 10000 Hz etc. 200000: 20000 Hz	Only effective if par. no. 9 = 3 0: Basic setting  If par. no. 20 = 0: only values from 1 (0,1Hz) to 20000 (2kHz) permissible.
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
Single bit error	Update 5
Short time interruption	Update 6
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

**Result structure short time interruption (NT)(line code 2B1Q)**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comments

## Detailed results format

Element	Description	Value								
0	Byte = Conformity of the measurement									
1	Byte = Trace line is updated	= 1 updated								
2	Byte = Currently set ppm value									
3	Byte = Interruption time in ms if mode of measurement Short Time Interruption has been selected									
4	Byte = Information on availability of measured values, see table									
5	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>X</td><td>X</td><td>X</td><td>X</td><td>act</td><td>usr1</td><td>usr2</td><td>ps1</td></tr></table> LSB	X	X	X	X	act	usr1	usr2	ps1	
X	X	X	X	act	usr1	usr2	ps1			
6	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>usr3</td><td>febe</td><td>ps2</td><td>ntm</td><td>cso</td><td>usr4</td><td>sai</td><td>usr5</td></tr></table> LSB	usr3	febe	ps2	ntm	cso	usr4	sai	usr5	
usr3	febe	ps2	ntm	cso	usr4	sai	usr5			
7	Byte = Reserve 4									
8	Byte = Reserve 5									
9	Byte = Reserve 6									
10	Byte = Reserve 7									
11	Byte = Reserve 8									
12	Byte = Reserve 9									
13	Byte = Reserve 10									
14,15	Word = Near and Block Error Counter									
16,17	Word = Far and Block Error									
18 ... 21	Real = Result measured time									
22 ... 25	Real = Result bit error ASIC24 U side									
26 ... 29	Real = Result error rate ASIC24 U side									
30 ... 33	Real = Result bit error ASIC24 S side									
34 ... 37	Real = Result error rate ASIC24 S side									
38 ... 437	Byte = ASCII text for trace line									

### 9.4.3.8 Short time interruption (LT) (line code 2B1Q)

Command: MEASURE [A], [B], [C] > [1], [2], ..., [25]

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	1 = Measurement SHORT TIME INTERRUPTION	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control:  1: Activation downstream 2: Activation upstream 3: Activation Loop 3 4: Single pulses	1: Basic setting 2 to 4 only effective if par. no.5 = 0
7	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting
8	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: MOS 5: Interruption	1: Basic setting
9	Interruption time 20: 20ms 21: 21ms 22: 22ms etc. 250: 250ms	20: Basic setting

(Continued)

No.	Description	Comments
10	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
11	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	2: Basic setting
12	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
13	Bit error measurement: 0: Off 1: On	0: Basic setting
14	Default 0	
15	Default 0	Reserve
16	Default 0	Reserve
17	Default 0	Reserve
18	Default 0	Reserve
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve

(Continued)

No.	Description	Comments
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
Single bit error	Update 5
Short time interruption	Update 6
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 3 is only possible if Trigger = Interruption, Update 5 is only possible if Single bit error = ON.



The result structure is identical to the one at the NT (see above) but with the following exceptions:

Element	Description	Value								
5	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>X</td><td>X</td><td>X</td><td>X</td><td>act</td><td>usr1</td><td>usr2</td><td>dea</td> </tr> </table> LSB	X	X	X	X	act	usr1	usr2	dea	
X	X	X	X	act	usr1	usr2	dea			
6	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>usr3</td><td>febe</td><td>usr4</td><td>usr5</td><td>usr6</td><td>usr7</td><td>uoa</td><td>alb</td> </tr> </table> LSB	usr3	febe	usr4	usr5	usr6	usr7	uoa	alb	
usr3	febe	usr4	usr5	usr6	usr7	uoa	alb			

### 9.4.3.9 Short time interruption (NT) (line code 4B3T)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [29]

No.	Description	Comments
A	0 = NT mode	
B	1 = Functional tests	
C	1 = Measurement SHORT TIME INTERRUPTION	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	1: Basic setting
5	S0-Interface: 0: Not active (off) 1: Active (TE function)	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 1 3: Activation Loop 2 4: Activation Loop 4 5: Send single pulses 6: Deactivation 7: Deactivation + Activation	6: Basic setting
7	Default 0	Reserve
8	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting
9	Clock: 0: Internal 1: External (2,048MHz) 2: External (1,536MHz) 3: Jittered	0: Basic setting

(Continued)

No.	Description	Comments
10	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: Interruption	1: Basic setting
11	Interruption time 20: 20ms 30: 30 ms 40: 40 ms etc. 250: 250ms	20: Basic setting
12	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10 B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external	<ul style="list-style-type: none"> <li>• only effective if</li> <li>• par. no. 5 = 0</li> <li>•</li> <li>•</li> </ul> 4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
13	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	0: Basic setting
14	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting



(Continued)

No.	Description	Comments
15	Bit error measurement: 0: Off 1: On	0: Basic setting
16	Jitter Deviat. Range: 0: 0,35 Ulss 1: 0,08 Ulss	Only effective if par. no. 9 = 3! 0: Basic setting
17	Jitter deviation: 4: 0,008 / 0,0020 Ulss 5: 0,010 / 0,0025 Ulss 6: 0,012 / 0,0030 Ulss etc. 150: 0,300 / 0,0750 Ulss 170: 0,350 / 0,0875 Ulss	Only effective if par. no. 9 = 3 4: Basic setting Conversion: par. no.16 = 0 Jitter Deviat.= (value *2)/1000 par. no.16 = 1 Jitter Deviat.= (value /2)/1000
18	Jitter frequency: 0: 0,0 Hz 1: 0,1 Hz 2: 0,2 Hz 10: 1,0 Hz 100: 10 Hz 1000: 100 Hz 1999: 199,9 Hz 10000: 1000 Hz 100000: 10000 Hz etc. 200000: 20000 Hz	Only effective if par. no. 9 = 3 0: Basic setting  If par. no. 20 = 0: only values from 1 (0,1Hz) to 20000 (2kHz) per- missible.
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve
26	Default 0	Reserve
27	Default 0	Reserve
28	Default 0	Reserve
29	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
Single bit error	Update 5
Short time interruption	Update 6
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

### Result structure short time interruption (NT) (line code 4B3T)

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comments

#### Detailed results format

Element	Description	Value
0	Byte = Conformity of the measurement	
1	Byte = Trace line is updated	= 1 updated
2	Byte = Currently set ppm value	
3	Byte = Interruption time in ms if mode of measurement Short Time Interruption has been selected	
4	Byte = Information on availability of measured values see table:	
5	Byte = Reserve 2	
6	Byte = Reserve 3	
7	Byte = Reserve 4	
8	Byte = Reserve 5	
9	Byte = Reserve 6	
10	Byte = Reserve 7	
11	Byte = Reserve 8	
12	Byte = Reserve 9	
13	Byte = Reserve 10	
14,15	Word = RDS-Counter	

(Continued)

Element	Description	Value
16,17	Word = Reserve 11	
18 ... 21	Real = Result measured time	
22 ... 25	Real = Result bit error ASIC24 U side	
26 ... 29	Real = Result error rate ASIC24 U side	
30 ... 33	Real = Result bit error ASIC24 S side	
34 ... 37	Real = Result error rate ASIC24 S side	
38 ... 437	Byte = ASCII text for trace line	

9.4.3.10 Short time interruption (LT) (line code 4B3T)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [25]

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	1 = Measurement SHORT TIME INTERRUPTION	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	1: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 3 3: Single pulses	1: Basic setting 2 to 3 only effective if par. no.5 = 0
7	Connection to device under test: 0: Direct 1: Attenuation 2: External line 3: External line with power feeding	0: Basic setting
8	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: Interruption	1: Basic setting
9	Interruption time 20: 20ms 30: 30 ms 40: 40 ms etc. 250: 250ms	20: Basic setting

(Continued)

No.	Description	Comments
10	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external	4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
11	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	2: Basic setting
12	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
13	Bit error measurement: 0: Off 1: On	0: Basic setting 1 only effective if par. no. 5 = 0
14	Default 0	
15	Default 0	
16	Default 0	
17	Default 0	
18	Default 0	
19	Default 0	
20	Default 0	
21	Default 0	

(Continued)

No.	Description	Comments
22	Default 0	Reserve
23	Default 0	Reserve
24	Default 0	Reserve
25	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
Single bit error	Update 5
Short time interruption	Update 6
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 3 is only possible if Trigger = Interruption, Update 5 is only possible if Single bit error = ON.



The result structure is identical to the one at the NT (see above) but with the following exceptions:

Element	Description	Value								
5	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>X</td><td>X</td><td>X</td><td>X</td><td>act</td><td>usr1</td><td>usr2</td><td>dea</td></tr></table> LSB	X	X	X	X	act	usr1	usr2	dea	
X	X	X	X	act	usr1	usr2	dea			
6	Byte = Bit structure overhead bits MSB <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td>usr3</td><td>febe</td><td>usr4</td><td>usr5</td><td>usr6</td><td>usr7</td><td>uoa</td><td>aib</td></tr></table> LSB	usr3	febe	usr4	usr5	usr6	usr7	uoa	aib	
usr3	febe	usr4	usr5	usr6	usr7	uoa	aib			

**9.4.3.11 Short time interruption (NT) (line code UP0)**

Command: MEASURE [A], [B], [C]&gt;[1], [2], ..., [29]

No.	Description	Comments
A	0 = NT mode	
B	1 = Functional tests	
C	1 = Measurement SHORT TIME INTERRUPTION	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 100 Ω	0: Basic setting
5	S0-Interface: 0: Not active (off) 1: active (TE function)	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 1 3: Activation Loop 2 4: Continuous pulses 5: Single pulses 6: Deactivate 7: Deactivate + Activate	4: Basic setting
7	Default 0	Reserve
8	Connection to device under test: 0: Direct 1: External line 2: External line with power feeding	0: Basic setting
9	Clock: 0: Internal 1: External (2.048MHz) 2: External (1.536MHz)	0: Basic setting

(Continued)

No.	Description	Comments
10	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: Interruption	1: Basic setting
11	Interruption time 20: 20ms 30: 30 ms 40: 40 ms etc. 250: 250ms	20: Basic setting
12	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	<ul style="list-style-type: none"> <li>•only effective if</li> <li>•par. no. 5 = 0</li> <li>•</li> <li>•</li> </ul> 4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
13	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	0: Basic setting
14	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting



(Continued)

No.	Description	Comments
15	Bit error measurement: 0: Off 1: On	0: Basic setting
16	Default 0	
17	Default 0	
18	Default 0	
19	Default 0	
20	Default 0	
21	Default 0	
22	Default 0	
23	Default 0	
24	Default 0	
25	Default 0	
26	Default 0	
27	Default 0	Reserve
28	Default 0	Reserve
29	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
Single bit error	Update 5
Short time interruption	Update 6
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME or Trigger = U CLOCK; Update 5 is only possible if Single bit error = ON.

**Result structure short time interruption (NT) (line code UP0)**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comments

## Detailed results format

Element	Description	Value
0	Byte = Conformity of the measurement	
1	Byte = Trace line is updated	= 1 updated
2	Byte = Currently set ppm value	
3	Byte = Interruption time in ms if mode of measurement Short Time Interruption has been selected	
4	Byte = Information on availability of measured values see table:	
5	Byte = Reserve 2	
6	Byte = Reserve 3	
7	Byte = Reserve 4	
8	Byte = Reserve 5	
9	Byte = Reserve 6	
10	Byte = Reserve 7	
11	Byte = Reserve 8	
12	Byte = Reserve 9	
13	Byte = Reserve 10	
14,15	Word = RDS - Counter	
16,17	Word = Reserve 11	
18 ... 21	Real = Result measured time	
22 ... 25	Real = Result bit error ASIC24 U side	
Element	Description	Value
26 ... 29	Real = Result error rate ASIC24 U side	
30 ... 33	Real = Result bit error ASIC24 S side	
34 ... 37	Real = Result error rate ASIC24 S side	
38 ... 437	Byte = ASCII text for trace line	

### 9.4.3.12 Short time interruption (LT) (line code UP0)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [25]

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	1 = Measurement SHORT TIME INTERRUPTION	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 100 Ω	0: Basic setting
5	S0 interface: 0: Off 1: Active	0: Basic setting
6	Control: 0: Activation downstream 1: Activation upstream 2: Activation Loop 3 3: Single pulses 4: Continuous pulses	1: Basic setting 2 to 4 only effective if par. no.5 = 0
7	Connection to device under test: 0: Direct 1: External line 2: External line with power feeding	0: Basic setting
8	Trigger: 0: No trigger 1: U frame 2: U clock 3: CIC 4: Interruption	1: Basic setting
9	Interruption time 20: 20ms 30: 30 ms 40: 40 ms etc. 250: 250ms	20: Basic setting

(Continued)

No.	Description	Comments
10	Data control: 0: B1+B2 Rx internal / Tx internal 1: B1+B2 Rx external / Tx internal 2: B1+B2 Rx internal / Tx external 3: B1+B2 Rx external / Tx external 4: B1 Rx internal / Tx internal 5: B1 Rx external / Tx internal 6: B1 Rx internal / Tx external 7: B1 Rx external / Tx external 8: B2 Rx internal / Tx internal 9: B2 Rx external / Tx internal 10: B2 Rx internal / Tx external 11: B2 Rx external / Tx external 12: MON+B* Rx external 13: MON Rx external 14: B * Rx external 15: B1+B2 Transparent	4: Basic setting  Rx internal: internal analysis of data coming from U. Rx external: transmit data coming from U to socket for external analysis. Tx internal: transmit data generated internally to U. Tx external: transmit external data to U.
11	PN pattern: 0: $2^{20} - 1$ 1: $2^{15} - 1$ 2: $2^{11} - 1$ 3: $2^9 - 1$ 4: Duration 0 5: Duration 1	2: Basic setting
12	Error: 0: No error 1: $10^{-3}$ 2: $10^{-4}$ 3: $10^{-5}$ 4: $10^{-6}$ 5: $10^{-7}$	0: Basic setting
13	Bit error measurement: 0: Off 1: On	0: Basic setting 1: Only effective if par. no. 5 = 0
14	8 Byte Reserve !!!	Reserve
19	Default 0	Reserve
20	Default 0	Reserve
21	Default 0	Reserve
22	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

TR <--	Update 1
TR -->	Update 2
Single bit error	Update 5
Short time interruption	Update 6
Delete bit error	Update 7

Update 1 and Update 2 are only possible if Trigger = U FRAME; Update 3 is only possible if Trigger = Interruption, Update 5 is only possible if Single bit error = ON.



The result structure is identical to the one at the NT (see above).

**9.4.3.13 Clock accuracy (NT) (line code 2B1Q)**

Command: MEASURE [A], [B], [C]&gt;[1], [2], ..., [12]

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	2 = Measurement CLOCK ACCURACY	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	Transmission clock: 0: Off 1: DUT sends single pulses 2: DUT sends U signal 3: Insertion loss	0: Basic setting  3 only effective if par. no. 1 = 0
9	Clock: 0: Internal	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock	0: Basic setting
11	Default 0	Reserve
12	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

f <--	Update 3
f -->	Update 4

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comment

## Detailed results format

Element	Description	Value
0	Byte = Reserve	
1	Byte = Reserve	
2	Byte = ppm-Wert (internal)	
3	Byte = Reserve	
4	Byte = Reserve	
5	Byte = Reserve	
6	Byte = Reserve	
7	Byte = ppm-value (only valid, if transmission clock = single pulses)	
8 ... 437	Byte = Reserve	

9.4.3.14 Clock accuracy (LT) (line code 2B1Q)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [12]

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	2 = Measurement CLOCK ACCURACY	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	Transmission clock: 0: Off 1: DUT sends single pulses 2: DUT sends U signals	0: Basic setting
9	Clock: 0: Internal	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock	0: Basic setting
11	Default 0	Reserve
12	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

f <--	Update 3
f -->	Update 4



**9.4.3.15 Clock accuracy (NT) (line code 4B3T)**

Command: MEASURE [A], [B], [C]&gt;[1], [2], ..., [15]

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	2 = Measurement CLOCK ACCURACY	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	Transmission clock: 0: Off 1: DUT sends single pulses 2: DUT sends U signals	0: Basic setting
9	Clock: 0: Internal	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock	0: Basic setting
11	Default 0	Reserve
12	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

f <--	Update 3
f -->	Update 4

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comment

## Detailed results format

Element	Description	Value
0	Byte = Reserve	
1	Byte = Reserve	
2	Byte = ppm value (internal)	
3	Byte = Reserve	
4	Byte = Reserve	
5	Byte = Reserve	
6	Byte = Reserve	
7	Byte = ppm value (only valid, if transmission clock = single pulses)	
8 ... 437	Byte = Reserve	

### 9.4.3.16 Clock accuracy (LT) (line code 4B3T)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [12]

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	2 = Measurement CLOCK ACCURACY	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 135 Ω 1: 150 Ω	0: Basic setting
5	Transmission clock: 0: Off 1: DUT sends single pulses 2: DUT sends U signals	0: Basic setting
9	Clock: 0: Internal 1: External (2,048MHz) 2: External (1,536MHz)	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock	0: Basic setting
11	Default 0	Reserve
12	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

f <--	Update 3
f -->	Update 4



The result structure is identical to the one at the NT (see above).

### 9.4.3.17 Clock accuracy (NT) (line code 4B3T)

Command: MEASURE [A], [B], [C]>[1], [2], ..., [12]

No.	Description	Comments
A	1 = NT mode	
B	1 = Functional tests	
C	2 = Measurement CLOCK ACCURACY	
1	Power: 0: Off 1: Normal 2: Normal with RL 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 100 Ω	0: Basic setting
5	Transmission clock: 0: Off 1: DUT sends single pulses 2: DUT sends U signals	0: Basic setting
9	Clock: 0: Internal	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock	0: Basic setting
11	Default 0	Reserve
12	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

f <--	Update 3
f -->	Update 4

**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Type of measured values	Numerical single values + ASCII string
Number of bytes	422
Results format	see below "Detailed results format"
Conformance test	No comment

## Detailed results format

Element	Description	Value
0	Byte = Reserve	
1	Byte = Reserve	
2	Byte = ppm value (internal)	
3	Byte = Reserve	
4	Byte = Reserve	
5	Byte = Reserve	
6	Byte = Reserve	
7	Byte = ppm value (only valid, if transmission clock = single pulses)	
8 ... 437	Byte = Reserve	

**9.4.3.18 Clock accuracy (LT) (line code UP0)**

Command: MEASURE [A], [B], [C]>[1], [2], ..., [12]

No.	Description	Comments
A	0 = LT mode	
B	1 = Functional tests	
C	2 = Measurement CLOCK ACCURACY	
1	Load: 0: Off 1: Normal 2: <b>Not used</b> 3: External	0: Basic setting
2	Load current (in steps of 1 mA) Range: 0...100 (0...100 mA)	Only effective if par. no. A = 0
3	Power feeding voltage (in steps of ¼ volt) Range: 40...480 (10...120 V)	Only effective if par. no. A = 1
4	Termination: 0: 100 Ω	0: Basic setting
5	Transmission clock: 0: Off 1: DUT sends single pulses 2: DUT sends U signals	0: Basic setting
9	Clock: 0: Internal	0: Basic setting
10	Trigger: 0: No trigger 1: U frame 2: U clock	0: Basic setting
11	Default 0	Reserve
12	Default 0	Reserve

The following settings can be triggered by the relevant UPDATE options:

f <--	Update 3
f -->	Update 4



The result structure is identical to the one at the NT (see above).

## 9.4.4 Jitter measurements

Type of measurement	Mode	Interface
Jitter	at the NT at the LT	2B1Q 4B3T

Jitter measurements can be performed on the NT. The jitter measurements are combined in measurement group 3 (cf. parameter B).

### 9.4.4.1 Jitter measurement on NT

Command: MEASURE [A], [B], [C]>[1], [2], ..., [13]

No.	Description	Comments
A	1 = Measurement on NT	
B	3 = Jitter measurement	
C	0 = JITTER MEASUREMENT	
1	Load/Power: 0: Off 1: Normal 2: <b>Not used</b> 3: External	
2	Load current (in steps of mA) Range 0...100(0...100) mA	
3	Power feeding voltage (in steps of 1/4V) Range: 40...480 (10...120 V)	
4	Jitter generator 0: Off 1: On	
5	Signal source  0: S0 1: U 2: Clock 80 kHz 3: Clock 120 kHz 4: Clock 256 kHz 5: Clock 512 kHz	
6	Frequency analysis range 0: 2 Hz - 20 kHz (63 lines) 1: 10 Hz - 200 Hz (20 lines)	
7	Evaluation Fu 0: <1 Hz 1: 5 Hz 2: 10 Hz 3: 15 Hz 4: 30 Hz 5: 50 Hz 6: 80 Hz 7: 110 Hz	Fu > Fo not permitted  ANSI = 80Hz

(Continued)

No.	Description	Comments
8	Evaluation Fo 0: 40 Hz 1: 270 Hz 2: 350 Hz 3: 600 Hz 4: 1 kHz 5: 3 kHz 6: 10 kHz 7: 20 kHz 8: 40 kHz	Fo < Fu not permitted
9	Measurement 0: Absolute jitter 1: Relative jitter	Only effective if par. no.4 = 1
10	Measuring range 0: 0 to 0.1 UI 1: 0 to 0.05 UI	
11	Jitter frequency range: 0: 0,1...200 Hz 1: 200 Hz...20 KHz	Only effective if par. no.4 = 1
12	Jitter frequency: 1: 0.1 Hz 2: 0.2 Hz 10: 1 Hz 100: 10 Hz 1000: 100 Hz 1999: 199.9 Hz 10000: 1000 Hz 100000: 10000 Hz etc.	Only effective if par. no.4 = 1  Resolution 0,1 Hz Range: 1...200 000 (0.1Hz.....20 kHz) for parameter 11 = 1; 1...2000 for parameter 11 = 0; 2000...200 000
13	Jitter deviation 1: 0,002/0,001 2: 0,004/0,002 etc. 19: 0,038/0,019 20: 0,040/0,020 21: 0,042/-- etc. 199:0,398/-- 200:0,400/--	Only effective if par. no.4 = 1  depending on parameter 08 Parameter 8 = 0; Jitter Deviat.: 1...200 Resolution 0.002 with 80 KHz clock Jitter Deviat. = Jitter Deviat. * 2:1000  Parameter 11 = 1; Jitter Deviat.: 1...20 Resolution 0,001 with 320 KHz clock Jitter Deviat. = Jitter Deviat. * 1:1000



**Result structure**

Command: RESULT? [0|1]

Type of measurement	Continuous measurement
Structure of measured values	Individual structure (Internal format code 3)
Number of bytes (for meas. values)	620
Number of measured values	see structure
Format / description (BYTE 0)	Y <sub>1</sub> = RESERVE
Format / description (BYTE 1)	Y <sub>2</sub> = RESERVE
Format / description (BYTE 2)	Y <sub>3</sub> = RESERVE
Format / description (BYTE 3)	Y <sub>4</sub> = RESERVE
Format / description (BYTE 4..7)	Y <sub>5</sub> (REAL) = UI (ss) measured value
Format / description (BYTE 8..11)	Y <sub>6</sub> (REAL) = UI (rms) measured value
Format / description (BYTE 12..15)	Y <sub>7</sub> (REAL) = UI (ss-peak-hold) measured value
Format / description (BYTE 16..275)	max 63 (REAL) BAR measured values (for Result only)
Format / description (BYTE 276..xxx)	xxx BYTE = currently without description
Conformance test	No

9.4.4.2 Jitter measurement on LT

Command: MEASURE [A], [B], [C]>[1], [2], ..., [13]

No.	Description	Comments
A	0 = Measurement on LT	
B	3 = Jitter measurement	
C	0 = JITTER MEASUREMENT	
1	Load/Power: 0: Off 1: Normal 2: Normal (Reserve) 3: External	
2	Load current (in steps of mA) Range 0...100(0...100) mA	
3	Power feeding voltage (in steps of 1/4V) Range: 40...480 (10...120 V)	
4	Jitter generator 0: Off	The jitter generator is always switched off for LT measurements
5	Signal source 0: U 1: S0 2: Clock 80KHz 3: Clock 256KHz 4: Clock 512KHz	
6	Frequency analysis range 0: 2Hz - 20kHz (63 lines) 1: 10Hz - 200Hz (20 lines)	
7	Evaluation Fu 0: <1 Hz 1: 5 Hz 2: 10 Hz 3: 15 Hz 4: 30 Hz 5: 50 Hz 6: 80 Hz 7: 110 Hz	Fu > Fo not permitted  ANSI = 80Hz
8	Evaluation Fo 0: 40 Hz 1: 270 Hz 2: 350 Hz 3: 600 Hz 4: 1 kHz 5: 3 kHz 6: 10 kHz 7: 20 kHz 8: 40 kHz	Fo < Fu not permitted

(Continued)

No.	Description	Comments
9	Default 0	
10	Measuring range 0: 0 to 0.1 UI 1: 0 to 0.05 UI	
11	Default 0	
12	Default 0	
13	Default 0	



The result structure is identical to the one at the NT (see above).

## 9.5 Event and status registers

The device is equipped with special registers which can be polled by the user to detect operating errors (e.g. entering an incorrect command), device status (e.g. device is in status STOP) and any exceeding of limit values (e.g. exceeding tolerance limits).

The following three **event registers** inform the user about events which have occurred in the device since the last poll of the registers:

- Event Status Register: ESR
- Event Register A: ERA
- Event Register B: ERB

Example: An incorrect command sets a fixed bit for "Command Error" in the Event Status Register. This bit remains set even if the correct commands are subsequently entered. Only when the Event Status Register is polled the bit for "Command Error" will be reset.

An **enable register** is assigned to each of the event registers.

- Event Status Register ESR: Event Status Enable ESE
- Event Register A ERA: Event Register A Enable ERAE
- Event Register B ERB: Event Register B Enable ERBE

A service request (SRQ) for an event which has occurred can be selectively disabled or enabled using the enable registers ESE, ERAE, ERBE and ERCE.

### Service request

Example: The service request (SRQ) addresses the control computer to output certain information on status or events in the device. For this purpose, there is a joint line (SRQ) on the IEC bus which can be activated by any connected device.

The following command will illustrate how a service request (SRQ) takes place. A service request SRQ is to be triggered by entering an incorrect command. A precondition is that bit 5 is set in the Event Status Enable Register. The Event Status Register is to have value 0. If an incorrect command is received, the device sets bit 5 (Command Error) CME in the event status register.

As a result, a logical AND operation is created between the Event and the Enable Register which yields the value 32. Since this value does not equal 0, the sum bit (Event Summary Bit, ESB) of the Event Status Registers is set. This sum bit will be entered at the appropriate place in a status byte.

The status byte also has an enable register (Service Request Enable Register, SRE). For the example described, bit 5 (enable ESB) of the SRE register must be set. The status byte and the SRE register will be ANDed and the resulting sum bit with value 1 will be entered in the status byte itself at position 6 (RQS). The device then triggers a service request (SRQ) via the IEC interface. Service requests from the event registers ERA, ERB and ERC are generated in the same way.

### Processing a service request (SRQ)

If the SRQ line of the IEC bus switches to 'LOW', the IEC bus controller runs a "Serial poll", i.e. the value of the status byte of the device requesting the SRQ is read. The RQS bit of the status byte indicates that this device has activated the SRQ. This device re-enables the SRQ line of the IEC bus by means of the "Serial poll".

The sum bits in the status byte can help to detect which events could have triggered the SRQ. In the present example, the sum bit EXB is set, upon which the appropriate event status register is polled to determine which event has occurred. The poll yields value 32, which means that the bit for "Command Error" has been set. Polling the Event Status Register will automatically erase this bit.

A new sum bit is created. It receives value 0 and is entered in the status byte. This in turn leads to the updating of the sum byte (RQS) which is also reset. If several sum bits are set in the status byte, the events can be processed consecutively in the same way

#### IEC standard commands: event and status registers

Set Event Status Enable Register	*ESE
Read Event Status Enable Register	*ESE?
Read Event Status Register	*ESR?
Set Parallel Poll Enable Register	*PRE
Read Parallel Poll Enable Register	*PRE?
Set Service Request Enable Register	*SRE
Read Service Request Enable Register	*SRE?
Read Status byte	*STB?
Read Parallel Poll Bit	*IST?
Set operation complete flag	*OPC
Read operation complete flag	*OPC?
Set Event Enable Register A	ERAE
Read Event Enable Register A	ERAE?
Read Event Register A	ERA?
Set Event Enable Register B	ERBE
Read Event Enable Register B	ERBE?
Read Event Register B	ERB?

### 9.5.1 Status byte (STB) with enable register (SRE)

MSB							LSB
0	RQS	ESR	MAV	ERA	ERB	ERC	0
D7	D6	D5	D4	D3	D2	D1	D0

RQS: Requested Service  
 ESR: Sum bit of the Event Status Registers  
 MAV: Sum bit of the Output Message Queue (Message Available)  
 ERA: Sum bit of the (device-dependent) Event Registers A  
 ERB: Sum bit of the (device-dependent) Event Registers B

Polling status byte:

Command **\*STB?** or IEC bus message sequence for "Serial Poll"

The status byte consists of the RQS bit (D6), the ESR sum bit (D5), the MAV bit (Message Available, D4) and the two sum bits ERA (D3), ERB (D2) and ERC (D1). Each individual bit describes the status of a register or of the output buffer.

The sum bits of the three event registers ESR, ERA, ERB and ERC have the logical value 1 if the result of their AND operation with the corresponding enable register is other than 0. In contrast, the MAV bit is set if a message is available in the output buffer of the device.

Each one of the sum bits D1-D5 can trigger an SRQ as long as the corresponding bit is set in the Enable Register. If at least one bit in the status byte or in the corresponding enable register SRE changes its value from logical 0 to logical 1, the AND operation is carried out on the two registers and an SRQ is triggered if the event is not equal to 0. This means that the RQS bit is set in the status byte and the SRQ line of the IEC bus is activated.

## 9.5.2 Service request enable register (SRE)

Request: **\*SRE?**

Response: >n (n= 0 and 255), decimal equivalent of the SRQ enable mask

Setting command: **\*SRE n**  
(n= 0 and 255), decimal equivalent of the SRQ enable mask with the following coding:

MSB						LSB	
0	0	c	d	e	f	0	0
D7	D6	D5	D4	D3	D2	D1	D0

c allows SRQ if Event Status Register  $\neq 0$  and enabling of the corresponding enable bits.

d allows SRQ if there is a message ( output queue not empty )

e allows SRQ if device-dependent Event Register A  $\neq 0$  and enabling by the corresponding enable bits

f allows SRQ if device-dependent Event Register B  $\neq 0$  and enabling by the corresponding enable bits

bit=1: corresponding SRQ enabled

bit=0: corresponding SRQ disabled

x: random

Bit 6 will register 0 independently of the value set.

### 9.5.3 Event status register (ESR) with enable register (ESE)

#### Event status register

MSB				LSB			
0	0	CME	EXE	0	QYE	0	OPC
D7	D6	D5	D4	D3	D2	D1	D0

CME: Command Error

Unknown command, syntax error, exceeding of the standard limit values of numerical parameters etc.

EXE: Execution Error

Exceeding of command-specific parameter limits, incompatibility of a command or parameter with the current operating status etc.

QYE: Query Error

The bit is set if the device is addressed as 'Talker' and no message is ready in the output queue.

OPC: Operation Complete

Information bit - is set after one or several sent commands have been carried out by the device. This is only effective if the command '\*OPC' was added to the command(s).

Request: \***ESR?**

Response: >n (n= 0 and 255), decimal equivalent of the event status registers

#### Event status enable register

The assignment of the event status enable register is similar to that of the event status register. The bits D0, D1, D3 and D6 are irrelevant.

Request: \***ESE?**

Response: >n (n= 0 and 255), decimal equivalent of enable mask

Setting command: \***ESE n**  
(n= 0 and 255), decimal equivalent of enable mask



### 9.5.4 Event register A (ERA) with enable register (ERAE)

#### Event register A

MSB				LSB			
0	0	0	d	0	0	0	0
D7	D6	D5	D4	D3	D2	D1	D0

d: Trace data available

Request: **ERA?**

Response: >n (n= 0 and 255), decimal equivalent of the event registers A

#### Event register A enable (ERAE)

Request: **ERAE?**

Response: >n (n= 0 and 255), decimal equivalent of enable mask A

Setting command: **ERAE n**  
(n= 0 and 255) , decimal equivalent of enable mask A

### 9.5.5 Event register B (ERB) with enable register (ERBE)

#### Event register B

MSB				LSB			
0	0	0	d	0	0	0	0
D7	D6	D5	D4	D3	D2	D1	D0

d: Status available

Request: **ERB?**

Response: >n (n= 0 and 255), decimal equivalent of event register B

#### Event register B enable (ERBE)

Request: **ERBE?**

Response: >n (n= 0 and 255), decimal equivalent of enable mask B

Setting command: **ERBE n**  
(n= 0 and 255), decimal equivalent of enable mask B

## 9.5.6 Parallel poll

When operating with the IEC interface, the device can be polled with the so-called 'parallel poll'. As response, a bit is placed on a specific line of the IEC data bus. The value of this bit indicates whether one of the bits in the status byte is other than 0. However, the status byte is connected with an enable mask prior to this (PRE, Parallel Enable) by an AND operation.

MSB						LSB	
0	rsv	ESR	MAV	ERA	ERB	0	h
D7	D6	D5	D4	D3	D2	D1	D0

rsv: sets parallel poll request bit, if device status has requested service

ESR: sets parallel poll request bit, if Event Status Register  $\neq 0$

MAV: sets parallel poll request bit, if Output Message Queue not empty (Message Available)

ERA: sets parallel poll request bit, if Event Register A  $\neq 0$

ERB: sets parallel poll request bit, if Event Register B  $\neq 0$

Request:            **\*PRE?**  
                       >n (n= 0 and 255), decimal equivalent of enable mask

Setting command: **\*PRE n**  
                       (n= 0 and 255), decimal equivalent of enable mask

The command:      **\*IST?**

may be polled in the form of a message as to whether the parallel request bit has been set.

Response: 0:      Parallel request bit not set  
               1:      Parallel-request bit is set



## 10 Appendix

On the following pages the technical data are listed. Subsequent to this you will be informed on how you can set-up the RS232 printer interface. Furthermore, there are notes on general care and maintenance as well as a service offer in this chapter.

## 10.1 Technical data

The technical data of the individual modules are listed below the data for the electrical measurements.

### 10.1.1 General data

#### Signal outputs and signal inputs

U Interface	Connection via two black safety sockets (4 mm) at the front panel Configurable for measurements on the NT
Protective earth conductor	Connection via a green/yellow safety socket (4 mm) at the front panel
Channel B input	Connection via BNC sockets at the front panel
Channel B output	Connection via BNC sockets at the front panel
Clock signal output	Connection via BNC sockets at the front panel
Frame clock signal output	Connection via BNC sockets at the front panel
Artificial line	Connection via two 2-pin TF

#### Remote supply

Internally supplied and configurable

Power feeding voltage  
Voltage range

Adjustable from 10 V to 120 V in steps of 0.25 V

Load current  
Current range

Max. 60 mA short-circuit proof  
Current limiting adjustable

#### Interfaces

IEC 625/IEEE 488 (24-pin)  
V.24 (25-pin) (suitable for graphics)  
as well as driver for IBM / EPSON  
compatible graphics printer or PC

#### Auxiliary supply

Mains connection	Protection class 1 (protective earth)
Line voltage Nominal range	Adjustable for 115 V or 230 V 115 V / 230 V -15 % to +10 %
Line frequency Nominal range Limit range for operation	50 Hz $\pm$ 5 %, 60 Hz $\pm$ 5 % 47 to 63 Hz
Power consumption	Approx. 80 VA without options Approx. 120 VA with options
Protective measures	in accordance with DIN VDE 0411

## 10.1.2 Environmental conditions

### Ambient temperature

Reference value	23 °C ± 1 °C
Nominal range	5 to 40 °C
Limit range for storage and transportation	-20 to +60 °C

### Relative humidity

Reference range at 23 °C	45 to 75 %
Nominal range	20 to 80 % (without condensation) Absolute humidity < 25 g/m <sup>3</sup>
Limit range of operation	10 to 90 % (without condensation) Absolute humidity < 30 g/m <sup>3</sup>

### Atmospheric pressure

Reference value	101.3 kPa (1013 mbar)
Nominal range	70.0 to 106.0 kPa (700 to 1060 mbar)
Limit range of operation	53.3 to 106.0 kPa (533 to 1060 mbar)
Radio interference suppression	According to assignment 1046/1984
Dimensions (w × h × d)	343 mm × 191 mm × 540 mm

### 10.1.3 Electrical measurements

#### Measurement of return loss

Measured value display	Characteristic of return loss dependent on frequency
Frequency range	1 kHz to 200 kHz
Frequency resolution	1 Hz
Frequency setting accuracy	$\pm 0.5 \text{ Hz} \pm 2 \text{ ppm}$
Measuring bandwidth	25 Hz and 2 kHz freely selectable
Measuring range	0 dB to 35 dB
Tolerance system	Fade-in as per ANSI T601 and ETSI TM 3.
Reference impedance	150 $\Omega$ and 135 $\Omega$
Measuring error	In the range of 5 kHz to 200 kHz and $a_r = 10 \text{ dB to } 25 \text{ dB} \quad \pm 0.5 \text{ dB}$ In the range of 1 kHz to 200 kHz and $a_r = 0 \text{ dB to } 35 \text{ dB} \quad + 1.5 \text{ dB} / - 0.5 \text{ dB}$

#### Measurement of longitudinal unbalance

Measured value display	Characteristic of longitudinal unbalance dependent on frequency
Frequency range	0.5 kHz to 200 kHz
Frequency resolution	1 Hz
Frequency setting accuracy	$\pm 0.5 \text{ Hz} \pm 2 \text{ ppm}$
Measuring bandwidth	25 Hz and 2 kHz freely selectable
Measuring range	20 dB to 70 dB
Tolerance system	Fade-in as per ANSI T601 and ETSI TM 3.
Reference impedance	150 $\Omega$ and 135 $\Omega$
Measuring error	In the range of 2 kHz to 50 kHz and $a_s = 20 \text{ dB to } 55 \text{ dB} \quad \pm 0.5 \text{ dB}$ In the range of 2 kHz to 50 kHz and $a_s = 55 \text{ dB to } 70 \text{ dB} \quad \pm 1.5 \text{ dB}$ In the range of 0.5 kHz to 200 kHz and $a_s = 20 \text{ dB to } 55 \text{ dB} \quad \pm 1.5 \text{ dB}$



**Measurement of longitudinal output voltage**

Measured value display	Characteristic of Longitudinal Output Voltage dependent on frequency
Frequency range	2.5 kHz to 300 kHz
Frequency resolution	1 Hz
Frequency setting accuracy	$\pm 0.5 \text{ Hz} \pm 2 \text{ ppm}$
Measuring range	-40 dBV to -90 dBV
Tolerance system	Fade-in as per ANSI T601
Reference impedance	150 $\Omega$ and 135 $\Omega$
Measuring error	In the range of 2.5 to 170 kHz and $a_{gl} = -40 \text{ to } -50\text{dBV} \quad \pm 0.5 \text{ dBV}$ In the range of 170 to 300 kHz and $a_{gl} = -50 \text{ to } 80\text{dBV} \quad \pm 1.0 \text{ dBV}$

(Averaging in accordance with ETSI and ANSI guidelines)

**Measurement of power spectral density**

Measured value display	Characteristic of measured level dependent on frequency
Frequency range	2.5 kHz to 1 MHz
Frequency resolution	1 Hz
Frequency setting accuracy	$\pm 0.5 \text{ Hz} \pm 2 \text{ ppm}$
Measuring bandwidth	2 kHz
Level measuring range	-20 dBm/Hz to -86 dBm/Hz
Level resolution	0.1 dB
Tolerance system	Fade-in as per ANSI T601
Reference impedance	150 $\Omega$ and 135 $\Omega$
Measuring accuracy	1 dB
Communication time	220 ms/measurement

**Measurement of total power**

Measured value display	Numeric
Frequency range	100 Hz to 80 kHz
Level measuring range	10 dBm to 15 dBm
Level resolution	0.1 dB
Reference impedance	150 $\Omega$ and 135 $\Omega$
Measurement accuracy	0.5 dB

**Measurement of noise voltage**

Frequency range	200 Hz to 2.5 kHz 2.5 kHz to 540 kHz 500 kHz to 1 MHz
Frequency resolution	1 Hz
Frequency setting accuracy	$\pm 0.5 \text{ Hz} \pm 2 \text{ ppm}$
Measuring bandwidth	25 Hz / 2 kHz
Voltage measuring range	0 mV <sub>eff</sub> to 10 mV <sub>eff</sub>
Resolution	0.01 mV
Tolerance system	Fade-in
Reference impedance	150 $\Omega$ and 135 $\Omega$
Measuring error	In the range of 200 Hz to 1 MHz and 1.0 mV to 10 mV      5 % of measured value $\pm 0.1 \text{ mV}$
Internal noise voltage	In the range of 25 kHz to 35 kHz $\leq 500 \mu\text{V}$ In the range of 0.5 kHz to 1 MHz $\leq 100 \mu\text{V}$

## 10.1.4 Power feeding tests

### Measurement of power consumption NT

Measured value display	Continuous numerical display of current, voltage and power values
Measurement duration	Unlimited
Measuring ranges:	
Voltage	10 V to 120 V
Current	a) 0 ... 50 mA b) 0 ... 10 mA c) 0 ... 2 mA d) 0 ... 500 $\mu$ A
Line resistor	a) Off (79 $\Omega$ ) b) 600 $\Omega$ c) 1000 $\Omega$ d) 1400 $\Omega$
Error limits:	
Voltage setting accuracy	0.7 % relative to upper range value 120 V
Voltage measuring accuracy (load internal)	
if feeding current $\leq$ 25mA	0.9 % relative to upper range value 120 V
if feeding current $\leq$ 50mA	1.1 % relative to upper range value 120 V
Voltage measuring accuracy (Load external)	0.7 % relative to upper range value 120 V
Current measuring accuracy	1.5 % relative to upper range value
Line resistor accuracy	2.5 % for current measuring range a) - c) and line resistor b) -d). 79 $\Omega \pm$ 10 $\Omega$ for current measuring range a) -c) and line resistor a). In the case of current measuring range d), the line resistor is increased by 240 $\Omega$ .

### Measurement start-up tests

Measured value display	Graphical output of current
Measurement duration	500ms, 1, 2, 4 and 8 s, 16 s, 32 s, 64 s
Measuring ranges:	
Voltage	10 V to 120 V
Current	a) 0 ... 100 mA b) 0 ... 50 mA c) 0 ... 10mA d) 0 ... 2mA e) 0 ... 500 $\mu$ A
Line resistor	a) Off (13 $\Omega$ ) b) 600 $\Omega$ c) 1000 $\Omega$ d) 1400 $\Omega$

## Error limits:

Voltage setting accuracy	0.7 % relative to upper range value 120 V
Current measuring accuracy	1.5 % relative to upper range value
Line resistor accuracy	2.5 % for current measuring range a) - c) and line resistor b) -d). $13\Omega \pm 1.5\Omega$ for current measuring range a) -c) and line resistor a). In the case of current measuring range d), the line resistor is increased by $240\Omega$ .

**Measurement of power condition LT**

Measured value display      Continuous numerical display of current, voltage and power values

Measurement duration      Unlimited

## Measuring ranges:

Load current      0.5mA to 100mA

## Error limits:

Load current setting accuracy if maximum load current is set from:

a) 50mA to 100mA	2% relative to upper range value 100mA
b) 10mA to 50 mA	2% relative to upper range value 50mA
c) 0.5mA to 10mA	2% relative to upper range value 10mA

Current measuring accuracy if maximum load current is set from:

a) 50mA to 100mA	1.5% relative to upper range value 100mA
b) 10mA to 50mA	1.5% relative to upper range value 50mA
c) 0.5mA to 10mA	1.5% relative to upper range value 10mA

## Current measuring accuracy

if load current  $\leq 25$ mA      0.9% relative to upper range value 120V

if load current  $\leq 50$ mA      1.1% relative to upper range value 120V

if load current  $\leq 100$ mA

a)  $T_A$ : 5°C - 30°C      1.3% relative to upper range value 120V

b)  $T_A$ : 30°C - 40°C      1.5% relative to upper range value 120V

## 10.1.5 Functional tests

### Measurement of frequency shifting

Master frequency 15.36 MHz	Changeable in steps of 1 ppm in the range of +127 ppm to -128 ppm
Activation	Measurement of duration of layer 1 setup
Deactivation	Measurement of duration of layer1 decay
Test loops	Switching of loops 1 (in the LT) Switching of loops 2 and 3 (in the NT)
Lines	Attenuation selectable 0 / 15 dB (device-internal) Looping-through of an external line or artificial line (EXTERNAL LINE sockets)
Measurement outputs	Coaxial / 50 $\Omega$
SCOPE 1 and SCOPE 2	Connection options for an oscilloscope or a transient recorder, For observation of the layer 1 signal before and after selectable attenuation or before and after the artificial line. Output level 20 dB +/- 0,2 dB lower than the layer 1 signal
TRIG. output	Trigger output with frame clock for the synchronization of an oscilloscope or a transient recorder.
Bit error measurement	
Generator	Quasi random sequences according to O.151: $2^{20}-1$ , $2^{15}-1$ , $2^{11}-1$ , $2^9-1$ . Duration 0 / Duration 1, Error display $10^{-9}$ to $10^{-7}$ and single bit error.  External coupling of a user signal via <i>B - IN</i> socket.
Receiver	Bit error counter to $2^{24}$ , Duration 0 recognition.  External analysis of the signal received via <i>B - OUT</i> socket.
Clock rates	64 kBit/s and 128 kBit/s
Internal disturbances	Selectable attenuation
External disturbances	Looping-through of an external line or artificial line (EXTERNAL LINE sockets)
Trigger signals	Frame clock The frame clock can be shifted continuously. CI trigger signal
Clock accuracy	15.36 MHz +/- 1ppm

**Measurement of short time interruption**

Short time interruptions	A sequence of 10 short-term interruptions adjustable in steps of 1 ms
Interruption time	in the range of 10 ms to 255 ms.
Activation	Measurement of duration of layer 1 setup
Deactivation	Measurement of duration of layer 1 decay
Test loops	Switching of loops 1 (in the LT) Switching of loops 2 and 3 (in the NT)
Lines	Attenuation selectable 0 / 15 dB (device-internal) Looping-through of an external line or artificial line (EXTERNAL LINE sockets)
Measurement outputs	Coaxial / 50 $\Omega$
SCOPE 1 and SCOPE 2	Connection options for an oscilloscope or a transient recorder for observation of the layer 1 signal before and after selectable attenuation or before and after the artificial line. Output level 20 dB +/- 0,2 dB lower than the layer 1 signal
TRIG. output	Trigger output with frame clock, for the synchronization of an oscilloscope or a transient recorder.

**Bit error measurement**

Generator	Quasi random sequences according to O.151: $2^{20}-1$ , $2^{15}-1$ , $2^{11}-1$ , $2^9-1$ . Duration 0 / Duration 1, Error display $10^{-3}$ to $10^{-7}$ and single bit error.  External coupling of a user signal via B - IN socket.
Receiver	Bit error counter to $2^{24}$ , Duration 0 recognition.  External analysis of the signal received via B - OUT socket.
Clock rates	64 kBit/s and 128 kBit/s
Internal disturbances	Selectable attenuation
External disturbances	Looping-through of an external line or artificial line (EXTERNAL LINE socket)
Trigger signals:	Frame clock The frame clock can be shifted continuously. CI trigger signal
Clock accuracy:	15.36 MHz +/- 1ppm

## 10.1.6 Jitter

### Jitter generator

Jitter frequency	
Frequency range I	0.1 Hz to 200 Hz, adjustable in steps of 0.1-Hz
Frequency range II	200 Hz to 20 kHz, adjustable in steps of 0.1-Hz
Intrinsic error	$\Delta f/f \leq 1 \cdot 10^{-4}$
Jitter amplitude	Sinusoidal
Frequency range I	0.002 $U_{I_{SS}}$ to 0.4 $U_{I_{SS}}$ , adjustable in steps of 0.002 $U_{I_{SS}}$ Error if 200 Hz: 1% of measured value
Frequency range II	0.001 $U_{I_{SS}}$ to 0.02 $U_{I_{SS}}$ , adjustable in steps of 0.001 $U_{I_{SS}}$ Error if 200 Hz : 1% of measured value
Jitter frequency response	Relative to jitter amplitude for 200 Hz
Frequency range I	up to 200 Hz: $1\% \pm 0.002 U_{I_{SS}}$
Frequency II	up to 10 kHz: $1\% \pm 0.001 U_{I_{SS}}$ up to 20 kHz: $2\% \pm 0.001 U_{I_{SS}}$
Clock output	BNC socket
Output impedance	$< 4 \Omega$
Signal level	$4 V < U < 5 V$ at $R_a \geq 75 \Omega$
Clock frequency	15.36 MHz

**Jitter meter**

## Evaluation I

Result display I	$U_{I_{SS}}$ , $U_{I_{SS-Max}}$ and $U_{I_{eff}}$ numeric
Measuring range I	0 to 0.1 $U_{I_{SS}}$ or 0 to 0.07 $U_{I_{eff}}$ Error of displayed jitter at 200 Hz jitter frequency: $1\% \pm 0.003 U_{I_{SS}}$
Measuring range II	0 to 0.05 $U_{I_{SS}}$ or 0 to 0.03 $U_{I_{eff}}$ Error of the displayed jitter at 200 Hz jitter frequency: $1\% \pm 0.002 U_{I_{SS}}$
Resolution of display	0.001 $U_{I_{SS}}$ or 0.001 $U_{I_{eff}}$
Bandwidth limitation	Selectable for $f_{min}$ and $f_{max}$ HP: 3dB limit frequency: $f_{min}$ : < 1,5,10,15,30,50,80,110 Hz Attenuation in the limit range: 20 dB / decade  TP: 3dB-limit frequency: $f_{max}$ : 270,350,600Hz; 1,3,10,20,40kHz Attenuation in the limit range: 20 dB / decade

## Evaluation II

Result display	Spectral contents of the jitter signal (graphic)
Frequency range I	$2 \text{ Hz} \leq f \leq 20 \text{ kHz}$ Partial range a up to 50 Hz with 2 Hz grid Partial range b up to 1 kHz with 50 Hz grid Partial range c up to 20 kHz with 1 kHz grid
Frequency range II	$10 \text{ Hz} \leq f \leq 200 \text{ Hz}$ to 200 Hz with 10 Hz grid
Repeat rate	ca. 1.5 s



**Signal input**

for jitter meter via basic device K1404, jitter box or external signal source

Input voltage	$U_{SS}=2\text{ V an }500\ \Omega$
Input socket	BNC

**Clock input**

for jitter meter and jitter generator via basic device K1404 or external signal source

Input voltage	$U_{SS}=4\text{ V}$
Reference clock	15.36 MHz
Input socket	BNC

**Jitter demodulator output**

for jitter analysis via external measuring devices

Output socket	BNC
Output impedance	$< 4\ \Omega$
Signal voltage	Measuring range K1404: 0 to $0.1 U_{I_{SS}}$ $U_{SS} = 0\text{ to }5.6\text{ V}$ 0 to $0.05 U_{I_{SS}}$ $U_{SS} = 0\text{ to }5.6\text{ V}$

### 10.1.7 IEC interface

Interface functions

SH 1, AH 1, T 6, L 4, TE 0, LE 0, SR 1, RL 0, DC 1, PP 1, DT 1, C0

Multiline interface messages

MLA, MTA, OTA, SPD, SPE, UNL, DCL, SDC, PPC, GET, PPU

Single-line interface messages

ATN, NDAC, NRFD, DAV, IFC, SRQ, EOI

Multiline device messages

DAB, STB, EOS, NUL, PPR

Data transmission

ISO-7-bit code or binary transmission according to DIN IEC 625, IEEE 488 with listener and talker functions

## 10.2 Set-up of V.24 printer interface

The connections can be established using so-called V.24/RS 232 adapter boards which are available at specialist shops.

When connecting a printer via a Centronics interface it is necessary to switch a serial-parallel converter and a 25-pin D-Sub socket with a 36-pin Centronics plug between the device and the printer. These converters often already allow for switching over between DATA TERMINAL EQUIPMENT and DATA COMMUNICATION EQUIPMENT so that changes in the pin assignments (as described below) are not required.

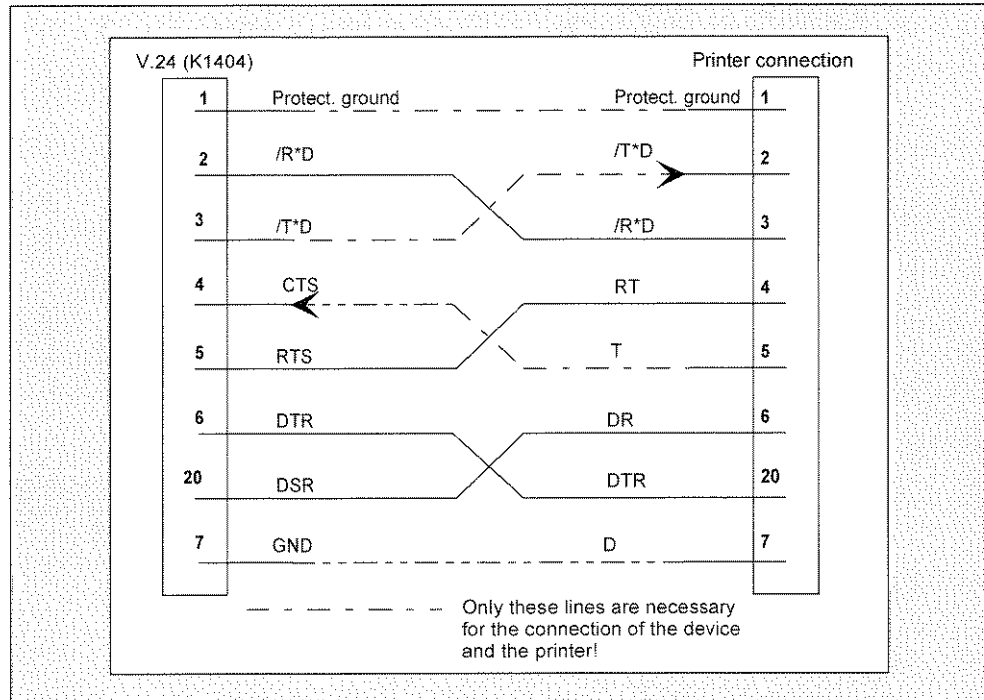


Fig. 10.1: Configuration of connection a of the V24 interface (K1404 printer)

The serial interface of the K1404 operates to the following specifications:

Baud rate	<b>9600</b>
Data bits	<b>8</b>
Stop bit	<b>1</b>
Parity	<b>Even</b>
Configuration	<b>DTE</b>

If a printer is connected which does not serve the CTS line at pin 4 of the serial interface, the CTS and RTS lines (pin 4 and 5 of the serial interface) can be isolated and pin 4 and 6 of the serial interface can be connected with each other at the K1404 device.

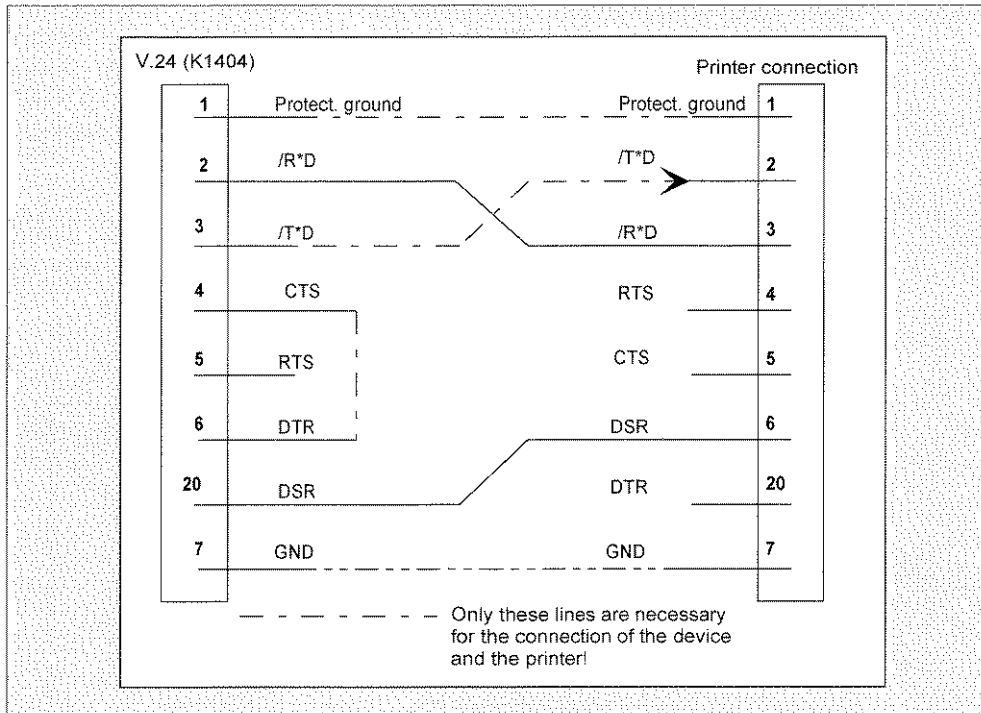


Fig. 10.2: Configuration of connection b of the V.24 interface (K1404 printer)

Connect K1404 with a 9-pin serial interface of a PC as follows:

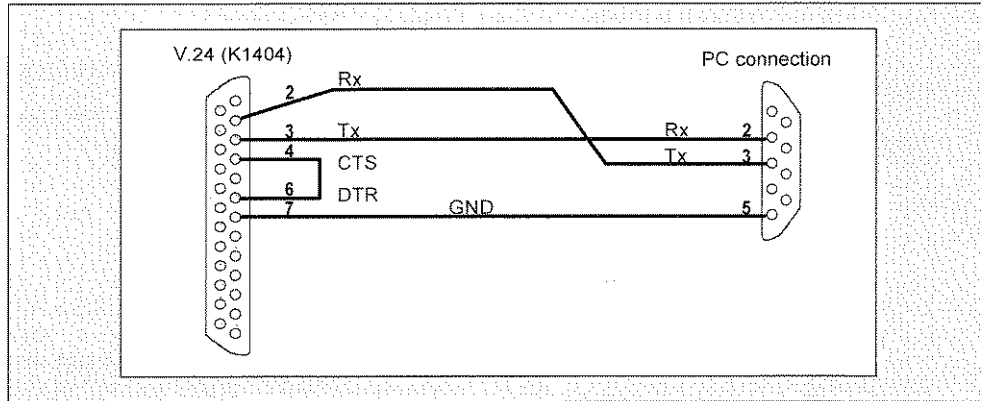


Fig. 10.3: Configuration of connection of the V.24 interface (K1404 9-pin PC serial port)

With a 25-pin serial interface, the following connections apply:

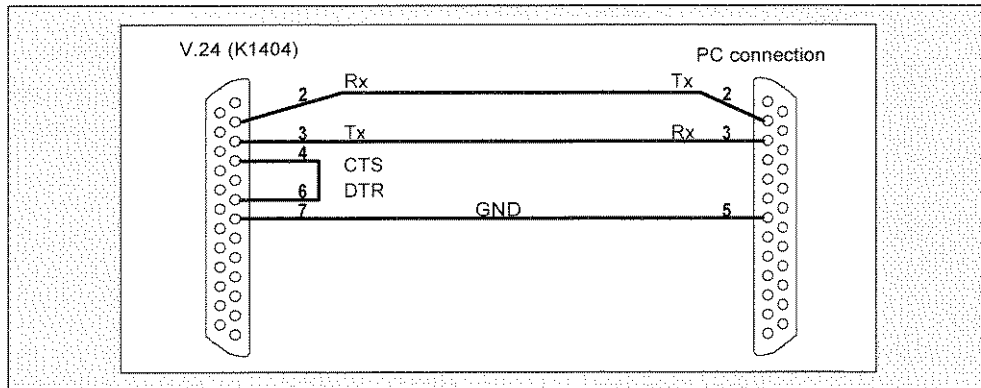


Fig. 10.4: Configuration of connection of the V.24 interface (K1404 25-pin PC serial port)

## 10.3 General Care and Maintenance

Please observe the following maintenance instructions:

- Prior to cleaning the K1404, switch off the device and disconnect the mains plug.
- All modules contain electrostatically sensitive components. Please observe the necessary safety instructions and ESD protection regulations



- A dry cloth is sufficient for cleaning the housing surface of K1404. In the event of substantial dirt accumulation, the external parts of the device, the touch screen and the keys can be cleaned using a cloth soaked in isopropanol. Do not use scouring powder nor plastic-solvent cleaning detergents. Cleaning the touch-screen and its border with solvent or abrasive cleaning detergents can lead to malfunction. No fluids may enter the interior of K1404.
- Only a service technician is permitted to clean the housing interior.
- Only authorized personnel is permitted to perform repairs on K1404. Unauthorized opening and improper repairs may cause severe hazards to the user. Please note our service offer below.



### **Warning!**

When operating electrical devices certain parts of these devices are inevitably under hazardous voltage. Improper handling of these devices may therefore cause death or severe bodily injuries as well as damage to the equipment.

### 10.3.1 Service offer

Siemens Karlsruhe, ANL A425 KRK offers factory servicing for the ISDN-U-Analyzer K1404 which ensures that the device is regularly serviced and carefully tested.

This service includes in detail:

- Cleaning the analyzer
- Checking the general functioning of the equipment
- Adjusting and re-setting the specified equipment parameters
- Upgrading the customer equipment HW / SW to current status supplied
- Extended test according to new equipment final test

Recommended service intervals: one service per year.

Extension of the service by inclusion of additional device HW/SW by mutual agreement.

Necessary repairs are carried out immediately upon notification. If the device warranty has expired, the accumulated spare parts and repairing costs will be billed separately.



If you send your K1404 to your Siemens service department for repairs, please attach the filled-in returned goods accompanying note. It ensures prompt handling of your request. You find this note in the brochure titled "Before you start".







