

ELEKTRONIKA

ELQ 30A

COPPER QUALIFIER

433-000-000

Operating Manual

OM 433-015-011xE

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1 INTRODUCTION

1.1 The Use of This Manual

This Operating Manual is intended to help the user in operating ELQ 30A explaining the operation rules. While following the instructions as given below, it is recommended to use the demo program found on the CD inside the back cover of this manual. Running the demo under WINDOWS will show you the front panel of the instrument with display and keyboard. By clicking with the mouse on the keyboard, the “virtual” ELQ 30A will behave as the real instrument, helping the user to carry out complete measuring procedures, but of course only “virtually”.

1.2 Application

Numerous Digital Subscriber Line systems (xDSL) appeared on the market to fulfill the need of faster data transfer for fast Internet access, remote LAN access and interactive multimedia etc. The “x” in xDSL indicates the different kinds of subscriber line technologies using the conventional copper local loops for fast data transfer. The xDSL modems using higher frequencies can achieve higher data rate than the plain old telephone services (POTS) on the same cable pairs. The main benefit of xDSL is that, there is no cable installation cost. The maximal loop length and the achievable maximal data rate depend on the cable quality.

Before the installation of xDSL modems we must be sure that the quality of the cable pair is sufficient for the given system.

ELQ 30A provides:

Measurement of all analogue parameters required for VDSL2, VDSL1, ADSL2+, ADSL2, ADSL, READSL, ADSL G.LITE, HDSL, SHDSL, ISDN, VF subscriber line qualification.

For line qualification:

- Automatic Single Ended line test programs
- Automatic End to End Master Slave test-programs
- Automatic achievable bit rate calculation for each xDSL system

For trouble shooting

- Numerous Single Ended and. End to End measurements
- Cable fault location with AC DC bridge
- Cable fault location with TDR

For data transfer

- USB Host Port for USB stick
- USB Device Port for PC connection













2 MAIN FEATURES

2.1 Keyboard and LEDs



Controls

	<p>Switches the ELQ 30A on and off. The instrument has an automatic switch-off feature to save battery life: switch-off takes place automatically 10 minutes after the latest keystroke. (see chapter settings for details)</p>
<p>F1 ... F6</p>	<p>The function of the six Function keys depends on the actual measuring mode.</p>
<p>START STOP</p>	<p>Starts or stops the selected measurement, program or process.</p>
<p>ENTER</p>	<p>This key is intended to acknowledge a selected measurement mode or a new parameter, or to carry out other changes.</p>

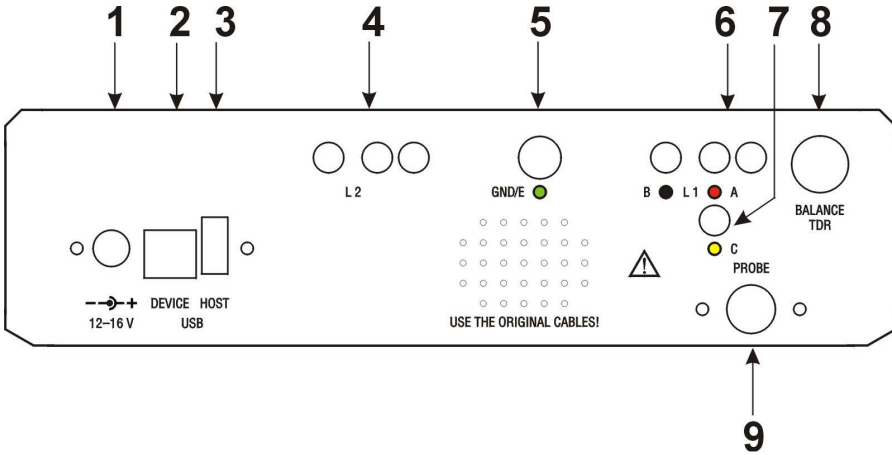
  	<p>These keys are intended to select the required measuring mode, to change a parameter or enter '0' or space</p>
 	<p>These keys are intended to select the required option and to adjust the position of vertical line cursor.</p>
	<p>This key is intended to enter a minus sign or to set a vertical maker in TDR mode or set # in telephone simulator mode</p>
	<p>This key can be used to cancel something.</p>
	<p>This key is intended to call the help function.</p>
	<p>This key can be used for the control of brightness</p>
	<p>Pressing this key the contents of display is copied to memory stick</p>
	<p>This key in TDR mode activates the SMOOTH function or enter a star character.</p>
	<p>This key enters '1'.</p>

ABC 2	This key enters '2' or A B C letters when required.
DEF 3	This key enters '3' or D E F letters when required.
GHI 4	This key enters '4' or G H I letters when required.
JKL 5	This key enters '5' or J K L letters when required.
MNO 6	This key enters '6' or M N O letters when required.
PQRS 7	This key enters '7' or P Q R S letters when required.
TUV 8	This key enters '8' or T U V letters when required.
WXYZ 9	This key enters '9' or W X Y Z letters when required.

LEDs

<input type="checkbox"/> MAINS	Mains indicator
<input type="checkbox"/> CHARGE	Charge indicator
<input type="checkbox"/> MEAS	Measurement indicator
<input type="checkbox"/> REMOTE	Remote control indicator

2.2 Connectors & Measuring Cables



1	2.1/5.5 mm coaxial connector for mains or 12V car adapter
2	USB connector for connecting a PC
3	USB connector for connecting an USB stick
4	L 2 line connector (Tx only)
5	Ground connector (E)
6	L 1 line connector (A & B)
7	Auxiliary line connector (C)
8	TDR balance
9	High impedance PROBE

Line connectors

ELQ 30A has two line connectors:

Connector LINE 1

For connecting A & B wires for each measurement and for the communication between the Master and Slave instruments.

Connector LINE 2

The Auxiliary LINE 2 connector is used only for transmitting white noise and test signal for cross-talk measurement.

Ground connector

In case of LCL balance and AC-DC bridge-measurements the GND socket of ELQ 30A should be inter-connected with the ground.

Auxiliary line connector

For connecting wire C at 3 Point measurement

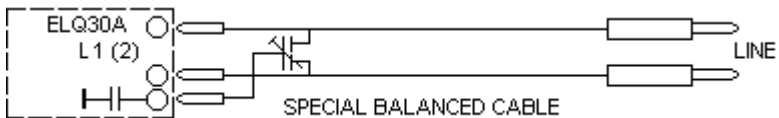
Measuring cables

Special balanced measuring cables

Two special balanced cables are provided with:

3-pole plug and a variable capacitor on the instrument-end

Red and black banana plugs on the line-end to connect the A & B wires of the tested line.



The measuring cables have two identifiers: L1 or L2 and the serial number of the instrument.

Ground cable

With green banana plugs at the two ends

Auxiliary line cable

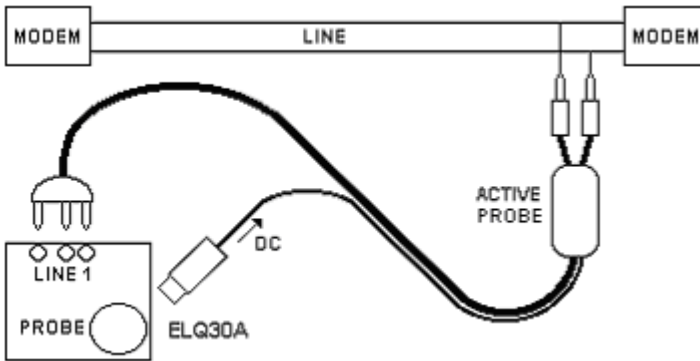
With yellow banana plugs at the two ends

High impedance active probe for PSD measurement (410-000-000)

For PSD spectrum measurement on working lines the test instrument should be connected parallel with the operating modems.

The digital systems are extremely sensitive for the capacitive load therefore the regular measuring cables can not be used to connect the instrument. For that purpose an active probe is provided with $< 5 \text{ pF}$ input capacity (It is powered from ELQ 30A). The active probe has two banana plugs on the line end and two plugs on the instrument end:

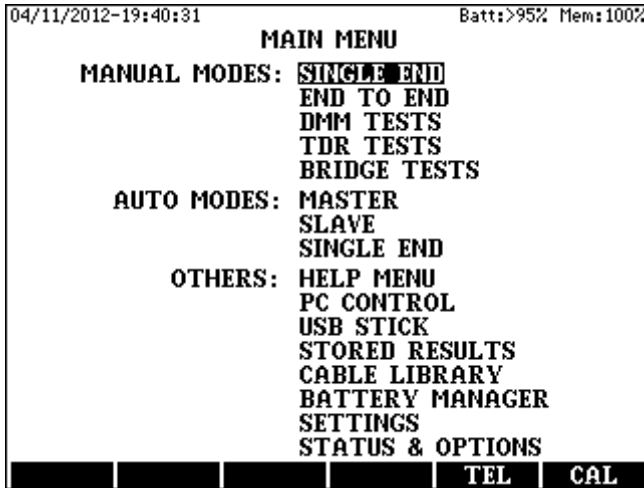
- 3-pole plug to be connected to LINE 1 connector
- Mini-din plug to be connected to the PROBE power output



3 OPERATING INSTRUCTIONS

3.1 Start up and General Rules

- Switch the instrument on.
- First the opening display appears showing the name and e-mail address of the manufacturer **ELEKTRONIKA**.
- After the percentage of the **BATTERY LEVEL** will be shown.
- 2 seconds later, self-test indication and the **MAIN MENU** appears



Basically, the user should follow the instructions appearing at the bottom of each display in all measurement modes.

- In most cases, the measuring, setting and editing modes are selected by the menu-driven operation system. For selection use the vertical cursor keys and then press **ENTER**.
- The various cable and test parameters can be selected with the function keys: **F1 to F6**. To facilitate and speed up operation, some of the measuring modes can be selected directly with them too.
- To return back to the previous display, press **ESC**.

Measurements can be started or stopped with the **START/STOP** key.

During the measurement the **MEAS** indicator LED is lighting

3.2 Self Calibration

The calibration of ELQ 30A can be started from the **MAIN MENU**.

Start of calibration:

- Press the **CAL (F6)** key.



Loss calibration

- Press the **LOSS (F2)** key and follow the appearing instructions

Bridge calibration

- Press the **BRIDGE (F5)** key and follow the appearing instructions

The conditions of the calibration are unchanged until the next calibration.

3.3 Saving and Recall of Test Results

When a test is completed the result can be saved in each measuring mode under a user given name. There are four identifiers of each stored results:

- **NAME** (user given name)
- **DATE** (automatically added)
- **TIME** (automatically added)
- **MODE** (automatically added)

The automatically added identifiers are very comfortable for the user, as the time is different for each test result, the same name can be used repeatedly.

Note: The operator's name would always be saved with the results as well, but it would appear on the PC after an upload of results. It should be given in before starting a measurement in **MAIN MENU / SETTINGS / OPERATOR'S NAME**. (Details in chapter Settings)

Saving of test results:

Having the test finished:

- Press the **SAVE (F1)** key
- Type an object name and press **ENTER**

Recall of test results.

- Enter the **MAIN MENU/STORED RESULTS** option
- Select the required result and press **ENTER**

Deleting a test result

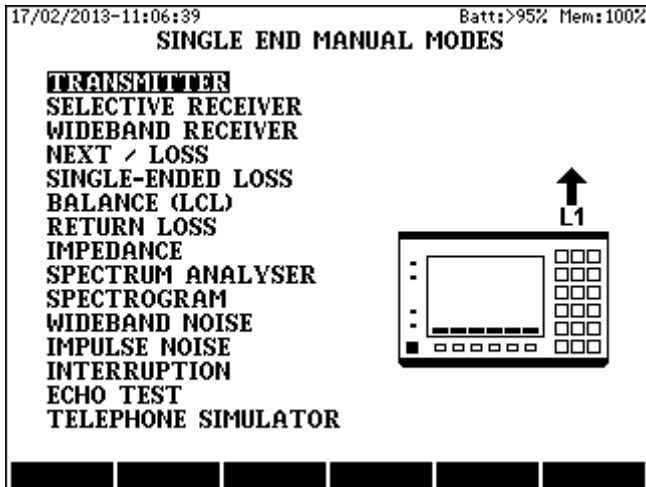
- Enter the **MAIN MENU/STORED RESULTS** option
- Select the result to be deleted and press **DELETE (F3)**
- If you are sure press **YES (F2)** otherwise **NO (F5)**

Deleting all the test results

- Enter the **MAIN MENU/STORED RESULTS** option
- Press **EMPTY (F1)**
- If you are sure press **YES (F2)** otherwise **NO (F5)**

4 MANUAL SINGLE ENDED TESTS

Enter the **MANUAL MODES: SINGLE END** option of **MAIN MENU**.
Having the **ENTER** key pressed the following display appears:



4.1 Transmitter

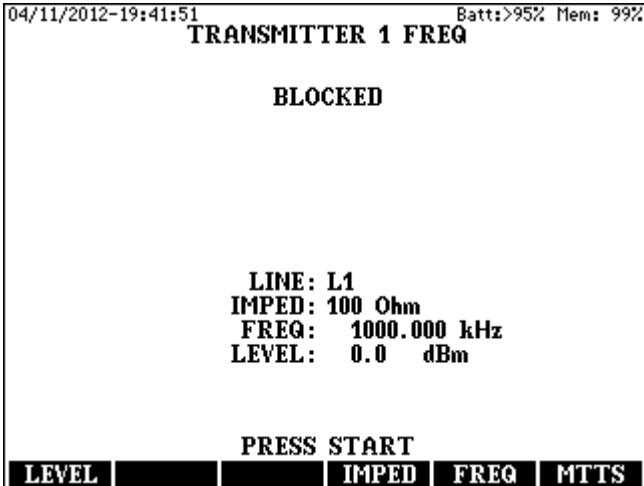
Two transmitting modes are provided:

- **1 FREQ** (generation of one single frequency)
- **MTTS** (generation of 30/35 frequencies at the same time)

The required mode can be selected with the **F6** key

Test Procedure

Enter **SINGLE END/TRANSMITTER** mode.



1 FREQ Transmitting Mode

Setting a new test-frequency

- Press the **FREQ (F5)** key
- Type in the required frequency and press **ENTER**

Modification of the actual test-frequency

- Press the **FREQ (F5)** key
- Select the required frequency step with the horizontal cursors
- Modify the frequency with the vertical cursors
- Press **ENTER**

Impedance selection

- Press the **IMPED (F4)** key
- Select the required impedance and press **ENTER**

Level setting

- Press the **LEVEL (F1)** key
- Type in the required level and press **ENTER**

MTTS Transmitting Mode

- Press the **MTTS (F6)** key.

Frequency range setting

- Press the **RANGE (F5)** key
- Select the required frequency range and press **ENTER**

Impedance setting

- Press the **IMPED (F4)** key.
- Select the required impedance and press **ENTER**

The output can be enabled or disabled with the **START/STOP** key.

4.2 Selective Receiver

Two selective receiving modes are provided:

- **1 FREQ** measurement on one single frequency)
 - **MTTS** (measurement on 30/35 frequencies at the same time)
- The required mode can be selected with the **F6** key

Test Procedure

- Enter **SINGLE END/SELECTIVE RECEIVER** mode



1 FREQ Receiving Mode

Setting a new test-frequency

- Press the **FREQ (F5)** key
- Type in the required frequency and press **ENTER**

Modification of the actual test-frequency

- Press the **FREQ (F5)** key
- Select the required frequency step with the horizontal cursors
- Modify the frequency with the vertical cursors
- Press **ENTER**

Band width selection

- Press the **BANDW (F2)** key
- Select the required band width and press **ENTER**

MTTS Receiving Mode

Frequency range setting

- Press the **RANGE (F5)** key
- Select the required frequency range and press **ENTER**

Input

- Pressing the **INPUT (F3)** key select the required line termination.
- Press the **IMPED (F4)** key
- Select the required impedance and press **ENTER**

For the proper dBm calculation the nominal line impedance (Z) should be given even if high input impedance is set.

The measurement can be started or stopped by the **START/STOP** key

Test results

The results are available both in graphic and numeric forms

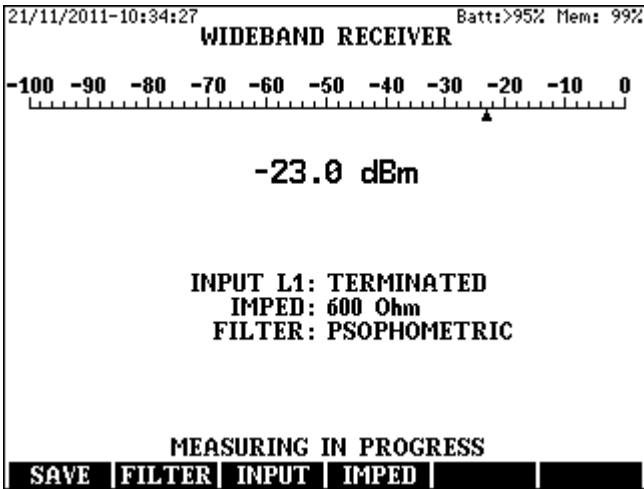
- In **1 FR** mode they are displayed together
- In **MTTS** mode the result is displayed first in graphic form but pressing the **LIST (F2)** key. Scroll the screen by pressing the **F5/F6** or **↑/↓** keys. To get back to graphic form press **ESC**.

4.3 Wideband Receiver

ELQ 30A provides wideband level measuring modes with auto ranging. To extend the measuring range several filters are available.

Test Procedure

- Enter **SINGLE END/WIDEBAND RECEIVER** mode



Line Termination

Pressing the **INPUT (F3)** key select the required line termination

Impedance selection

- Press the **IMPED (F4)** key
- Select the required impedance and press **ENTER**.

For the proper dBm calculation the nominal line impedance (Z) should be given even if high input impedance is set.

Filter Selection

- Press the **FILTER (F2)** key and enter the required filter option

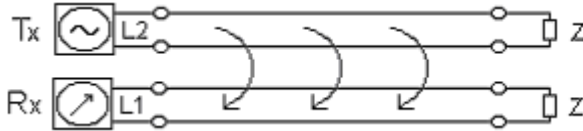
The measurement can be started or stopped by the **START/STOP** key

Test Results

Test results are available both in graphic and numeric forms

4.4 NEXT / LOSS Measurement

Near-end cross talk (NEXT) is a major impairment for systems that share the same frequency band for upstream and downstream transmission. The NEXT can be measured by transmitting on L2 and receiving on L1.



ELQ 30A calculates the NEXT value as the ratio of transmitted and received powers. The higher the NEXT the better the cross talk.

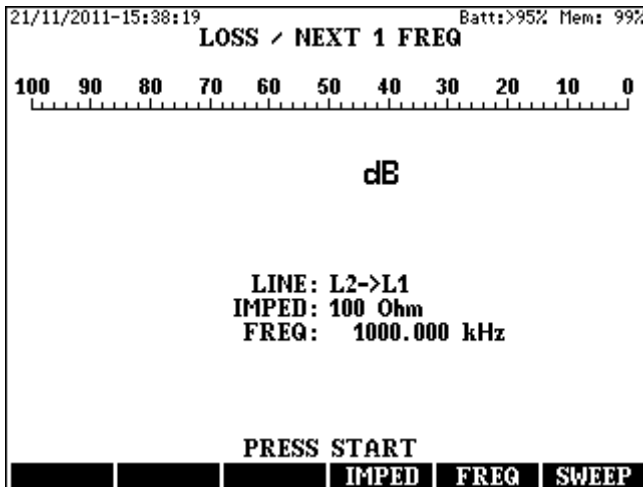
Two measuring modes are provided:

- **1 FREQ** (measurement on one single frequency)
- **SWEEP** (measurement on 60 frequencies)

The required mode can be selected with the **F6** key

Test Procedure

Enter **SINGLE END/NEXT** mode



1 FREQ Mode

Setting a new test-frequency

- Press the **FREQ (F5)** key
- Type in the required frequency and press **ENTER**

Modification of the actual test-frequency

- Press the **FREQ (F5)** key
- Select the required frequency step with the horizontal cursors
- Modify the frequency with the vertical cursors and press **ENTER**

SWEEP Mode

- Press the **SWEEP (F6)** key.
- Press the **RANGE (F5)** key and enter the required frequency range

Impedance

- Press the **IMPED (F4)** key and select the required impedance
- The measurement can be started or stopped by the **START/STOP** key

Test Results

Test results are available both in graphic and numeric forms.

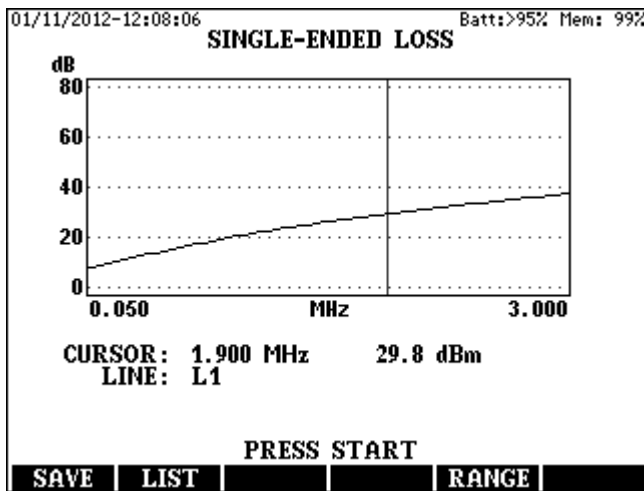
- In **1 FR** mode they are displayed together
- In **SWEEP** mode the result is displayed first in graphic form. To get numeric form, press the **LIST (F2)** key. This will stop the Measurement. Scroll the screen by pressing the **F5/F6** or **↑/↓** keys. To get back to graphic form press **ESC**.

4.5 Single Ended Loss

ELQ 30A provides single ended loss estimation.

Test Procedure

Enter **SINGLE END / SINGLE-ENDED LOSS** mode



- Press the **RANGE (F5)** key and enter the required frequency range

Test Results

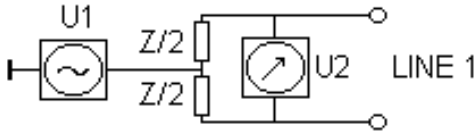
Test results are available both in graphic and numeric forms

- To get numeric form, press the **LIST (F2)** key. Scroll the screen by pressing the **F5/F6** or **↑/↓** keys.
- To get back to graphic form press **ESC**.

4.6 Longitudinal Balance Measurement

Longitudinal currents can cause noises on the line if the balance is imperfect. Longitudinal balance ratio (LCL) reflects the ability of line to suppress the effects of longitudinal currents.

ELQ 30A provides LCL measurement using the test circuit recommended by ITU-T. Rec. 0.9

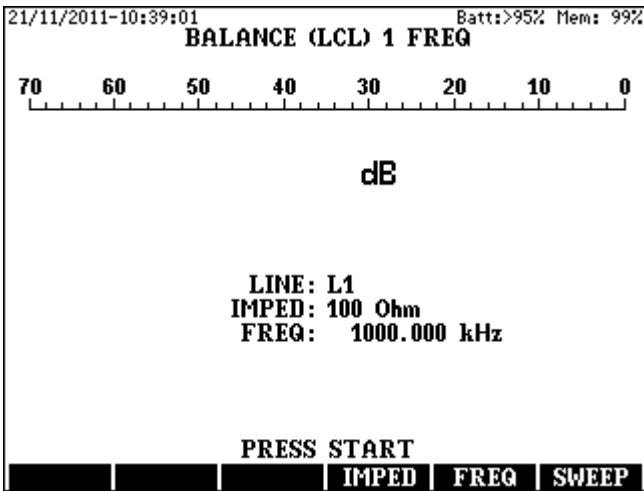


$$LCL = 20 \log U1/U2 \text{ dB}$$

The better the balance of a cable pair the higher is LCL in dB.

Test Procedure

- Enter **SINGLE END/BALANCE** mode



Two measuring modes are provided:

- **1 FREQ** (measurement on one single frequency)
- **SWEEP** (measurement on 60 frequencies)

The required mode can be selected with the **F6** key

1 FREQ Mode

Setting a new test-frequency

- Press the **FREQ (F5)** key
- Type in the required frequency and press **ENTER**

Modification of the actual test-frequency

- Press the **FREQ (F5)** key
- Select the required frequency step with the horizontal cursors
- Modify the frequency with the vertical cursors and press **ENTER**

SWEEP Mode

- Press the **SWEEP (F6)** key.
- Press the **RANGE (F5)** key and enter the required frequency range

Impedance

- Press the **IMPED (F4)** key and select the required impedance

The measurement can be started or stopped by the **START/STOP** key

Test Results

Test results are available both in graphic and numeric forms.

- In **1 FR** mode they are displayed together
- In **SWEEP** mode the result is displayed first in graphic form. To get numeric form, press the **LIST (F2)** key. This will stop the measurement. Scroll the screen by pressing the **F5/F6** or **↑/↓** keys. To get back to graphic form press **ESC**

The specified accuracy can be guaranteed only if the used L1 test cable and the instrument have the same serial number

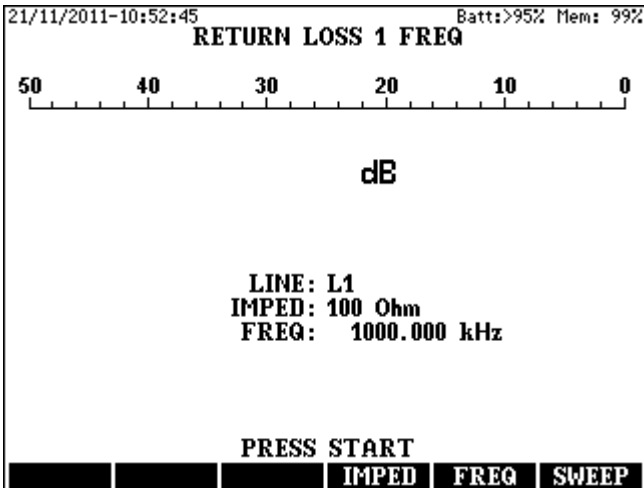
4.7 Return Loss Measurement

Return Loss factor indicates the deviation of line impedance from the nominal value.

$$RL = 20 \log \left| \frac{Z_{line} + R_n}{Z_{line} - R_n} \right| \text{ [dB]}$$

Test Procedure

- Enter **SINGLE END/RETURN LOSS** mode



Two measuring modes are provided:

- **1 FREQ** (measurement on one single frequency)
- **SWEEP** (measurement on 60 frequencies)

The required mode can be selected with the **F6** key

1 FREQ Mode

Setting a new test-frequency

- Press the **FREQ (F5)** key
- Type in the required frequency and press **ENTER**

Modification of the actual test-frequency

- Press the **FREQ (F5)** key
- Select the required frequency step with the horizontal cursors
- Modify the frequency with the vertical cursors and press **ENTER**

SWEEP Mode

- Press the **SWEEP (F6)** key.
- Press the **RANGE (F5)** key and enter the required frequency range

Impedance

- Press the **IMPED (F4)** key and select the required impedance

The measurement can be started or stopped by the **START/STOP** key

Test Results

Test results are available both in graphic and numeric forms.

- In **1 FR** mode they are displayed together
- In **SWEEP** mode the result is displayed first in graphic form. To get numeric form, press the **LIST (F2)** key. This will stop the measurement. Scroll the screen by pressing the **F5/F6** or **↑/↓** keys. To get back to graphic form press **ESC**

4.8 Impedance Measurement

In this mode the absolute value of line impedance can be measured.

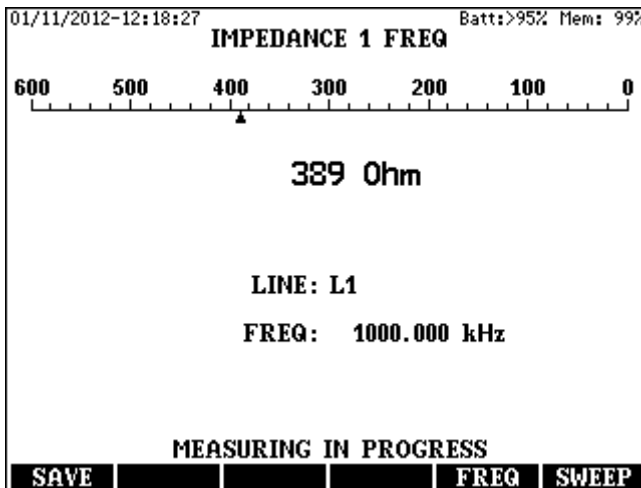
Two measuring modes are provided:

- **1 FREQ** (measurement on one single frequency)
- **SWEEP** (measurement on 60 frequencies)

The required mode can be selected with the **F6** key

Test Procedure

- Enter **SINGLE END/IMPEDANCE** mode



1 FREQ Mode

Setting a new test-frequency

- Press the **FREQ (F5)** key
- Type in the required frequency and press **ENTER**

Modification of the actual test-frequency

- Press the **FREQ (F5)** key
- Select the required frequency step with the horizontal cursors
- Modify the frequency with the vertical cursors and press **ENTER**

SWEEP Mode

- Press the **SWEEP (F6)** key.
- Press the **RANGE (F5)** key and enter the required frequency range

The measurement can be started or stopped by the **START/STOP** key

Test Results

Test results are available both in graphic and numeric forms.

- In **1 FR** mode they are displayed together
- In **SWEEP** mode the result is displayed first in graphic form. To get numeric form, press the **LIST (F2)** key. This will stop the measurement. Scroll the screen by pressing the **F5/F6** or **↑/↓** keys. To get back to graphic form press **ESC**.

4.9 Spectrum Analyzer

In this mode ELQ 30A can be used as a spectrum analyzer.

Frequency range: 200 Hz to 30 MHz

Input modes: 100, 135, 150, 600 Ohm, Unterminated and High Imp Probe

The high impedance active probe provides 5 kOhm || 5pF input impedance.
(The 15 dB loss of high impedance probe is automatically compensated)

Display modes:

- **dBm** display mode
- **dBm/Hz** display mode

Evaluation modes:

- **NORM**. Displaying the actual value of input signal
- **PEAK** Displaying the peak value of input signal
- **AVG** Displaying the average value of input signal
- **SAVG** Displaying the average of the last 10 measurements

The number of displayed frequencies: 300

Selectable frequency ranges: 0.3, 4, 20 kHz

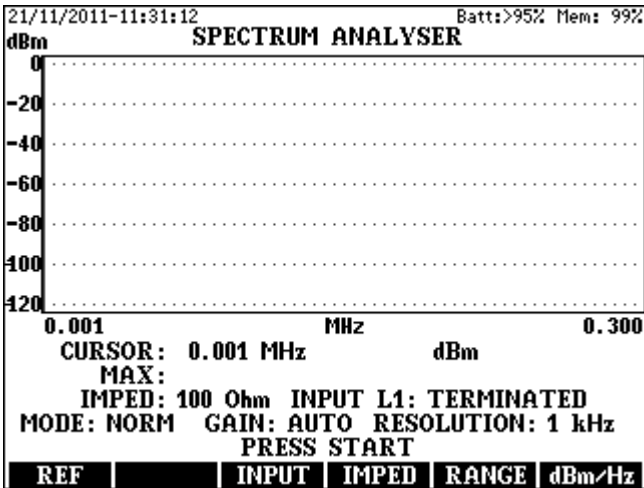
0.3, 0.6, 1.5, 3, 9, 12, 18, 30 MHz

The selectable bandwidth depends on the selected range. The following table shows the selectable, bandwidths and frequency steps for the different frequency ranges. (ZOOM facility)

Frequency Range	Bandwidth and Frequency step
30 MHz	500 Hz to 100 kHz
18 MHz	500 Hz to 60 kHz
12 MHz	500 Hz to 40 kHz
9 MHz	500 Hz to 30 kHz
3 MHz	500 Hz to 10 kHz
1.5 MHz	500 Hz to 5 kHz
600 kHz	500 Hz to 2 kHz
300 kHz	500 Hz to 1 kHz
20 kHz	50 Hz to 100 Hz
4 kHz	10 Hz to 20 Hz
0.3 kHz	1 Hz

Test Procedure

- Enter **SINGLE END/SPECTRUM ANALISER** mode



Settings before the measurement

- Press the **RANGE (F5)** key and enter the required frequency range
- Press the **INPUT (F3)** key and select the required input mode.
- Press the **IMPED (F4)** key and enter the nominal line impedance
- Set the impedance even if you use the high impedance probe because it is needed for calculations as well.
- Select the display mode (dBm or dBm/Hz) with the **F6** key

Settings when the measurement is running

- Press the **MODE (F4)** key and enter the required evaluation mode
- Set the cursor on the critical point of the spectrum
- Press the **ZOOM (F6)** key and enter the required band width
- Press the **GAIN (F3)** key if you want to use fix gain instead of auto ranging and enter the required gain

Test results

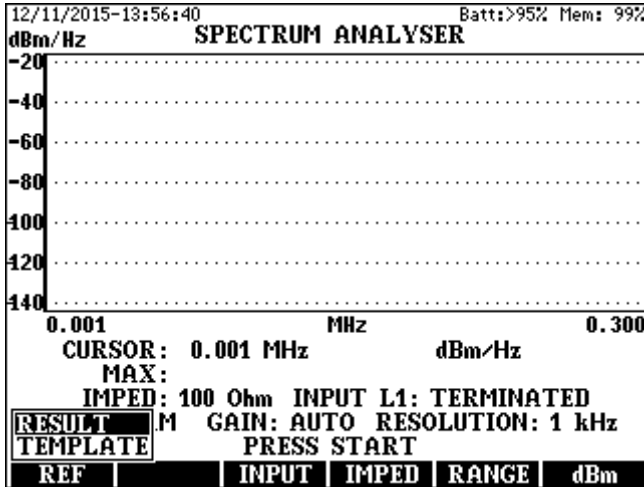
The test results are displayed first in graphic form during the Measurement. To get numeric form:

- Interrupt the Measurement by the **START/STOP** key,
- Press the **LIST (F2)** key and the result appears in numeric form.
- Scroll the screen by pressing the **F5/F6** or **↑/↓** keys. To get back to graphic form press **ESC**

4.9.1 Stored Result as Reference

An earlier obtained test result can be used as reference if the trace as reference option is activated. To recall the stored reference trace:

- Press **REF (F1)**
- Enter the **RESULT** option



- Enter the stored result to be used as reference

The screenshot shows the 'STORED RESULTS' menu. At the top, it displays the date and time '12/11/2015-14:00:42' and battery status 'Batt:>95% Mem: 99%'. Below the title, it asks for the 'OPERATOR'S NAME'. A table lists the stored results:

RESULT NAME	MEAS MODE	START TIME
1	SPECTRUM	12/11/2015-13:59
2	SPECTRUM	12/11/2015-14:00

At the bottom of the screen, a 'PgDn' key is visible.

The measurement can be started or interrupted by the **START/STOP** key

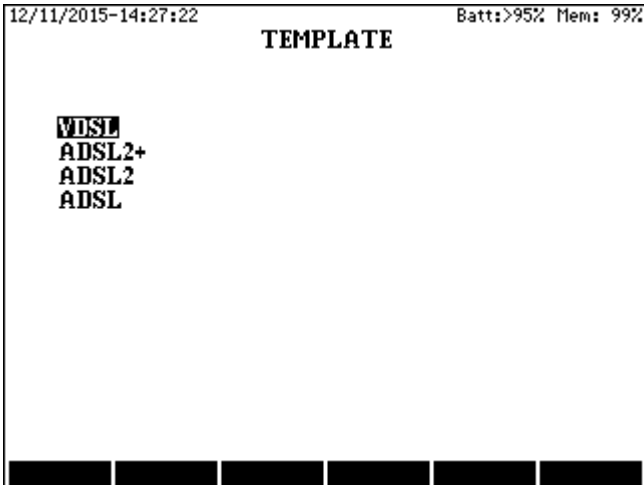
4.9.2 ITU PSD Mask as Reference

Transmitting power of DSLAM-s are limited. The PSD of transmitted signal mustn't exceed the PSD mask recommended by ITU.

ELQ 30A provides the possibility to display the actual output spectrum of an operating DSLAM together with the recommended PSD mask.

To recall the corresponding PSD mask:

- Press **REF (F1)**
- Enter the **TEMPLATE** option



- When the **TEMPLATE** menu appears select a system group
- Do the DPBO and UPBO adjustment if necessary
- Enter the required system

Doing so ELQ 30A automatically set the proper frequency range and shows the PSD mask belonging to the selected system.

The measurement can be started or interrupted by the **START/STOP** key

Application Notes

The accuracy of the spectrum measurement depends on the proper setting of evaluation mode, display mode and bandwidth. There are two typical measuring tasks:

- PSD spectrum Measurement on working lines
- Noise spectrum Measurement on passive lines
- PSD Spectrum Measurement on Working Lines

Line connection

In this case the test instrument should be connected parallel to the line with high impedance. The digital systems are extremely sensitive for the capacitive load therefore the regular measuring cables can not be used to connect the instrument. For line connection an optional active probe is provided to ELQ 30A with a high input-impedance: $> 5 \text{ k}\Omega < 5 \text{ pF}$.

The loss of high impedance probe is automatically compensated if the **HIGH IMPEDANCE PROBE** input option is selected.

The suggested settings to reach the best test results

As the actual transmit power of the tested modem is changing according to the actual data transfer situation the best is to set:

- Wide bandwidth
- **dBm/Hz** display mode
- **AVG or SAVG** evaluation mode

Noise Spectrum Measurement on Passive Lines

Line connection

Both ends of the tested line should be terminated. The use of the special balanced cable of ELQ 30A is recommended for this measurement.

The suggested settings to reach the best test results

There are two typical types of noises:

Wide band cross-talk noises caused by other xDSL systems

Discrete frequency noises caused by radio stations

For the analysis of wide band cross talk noises the best is to set:

Wide bandwidth

- **dBm/Hz** display mode
- **NORMAL** evaluation mode

For the analysis of discrete frequency noises the best is to set:

The narrowest bandwidth

- **dBm** display mode
- **AVG or SAVG** evaluation mode

4.10 Spectrogram

The purpose of Spectrogram PC program is to boost the spectrum measurement abilities of ELQ 30A utilizing the memory capacity of a PC or an USB stick.

In this mode ELQ 30A performs spectrum measurements in every second and the obtained results are stored at the connected external device. The large external memory capacity allows the storage the results of long test sequences up to 72 hours

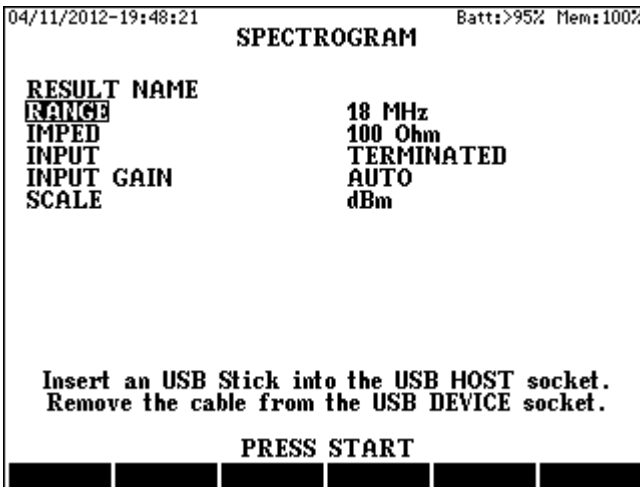
Tasks when the external device is a PC.

- Connect the PC to the USB Device Port of ELQ 30A
- Select the **PC CONTROL** option of the **MAIN MENU**

The further steps can be found in the Operating Manual of Control Program

Tasks when the external device is USB stick

Enter the **SINGLE END / SPECTROGRAM** mode.



When the **SPECTROGRAM** display appears:

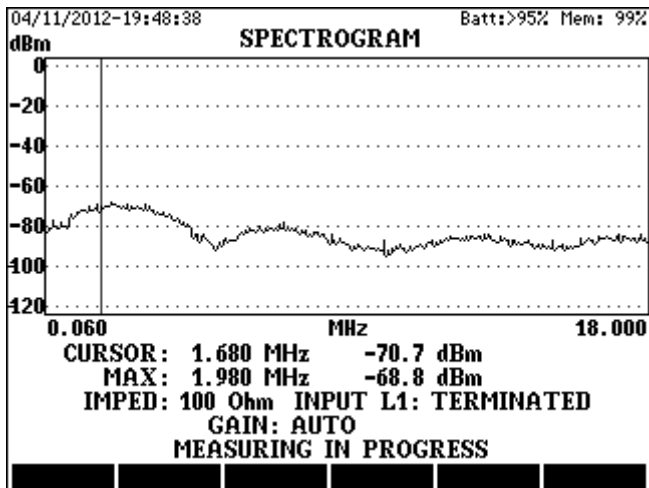
- Select the **RESULT NAME** option with the vertical cursor keys
- Press **ENTER**
- Type in a result name
- Press **ENTER** again

Set the test parameters using the cursor keys.

- Select the parameter with the vertical cursor keys
- Modify the selected parameter with the horizontal cursor keys

Start the test sequence with the **START/STOP** key

Doing so, the display of actual spectrum situation appears.



The test sequence can be finished with the **START/STOP** key

4.11 Wideband Noise Measurement

Noises reduce the data transfer capability of subscriber lines. The transmitted signal suffers from impairments due to noises. Noise on the telephone line normally occurs because of improper balance, cross talk and bad splices. The wideband noise can be characterized by power level (RMS value) and frequency spectrum. The received noise signal is named wideband noise when its peaks don't exceed the RMS value more than 12 dB ($U_{PEAK} < 4 U_{RMS}$)

ELQ 30A provides filters for numerous European frequency band-planes. The proper measurement time depends on the nature of noise. In case of a quasi-stationary noise 1 to 10 sec is enough. If the noise level is slowly changing, a longer measurement time provides the proper test result.

Selectable measuring times:

- 1, 5, 10, 30 sec
- 1, 5, 10, 30 min
- 1, 2, 4, 8, 12, 24, 48, 72 hours

Continuous measurement

The impairment of communication caused by noises does not depend only on the level but also on the time distribution of noise.

When >1 min measuring time is selected ELQ 30A displays the noise level in histogram form with 60 time slots providing information about the time distribution.

Test Procedure

- Enter **SINGLE END/WIDEBAND NOISE** mode
- Press the **DUR (F5)** key and enter the required measurement time
- Press the **FILTER (F2)** key and enter the required filter option
- Press the **INPUT (F3)** key and enter the required line termination.
For the proper dBm calculation the nominal line impedance (Z) should be given even if high input impedance is set.
- Press the **IMPED (F4)** key and enter the required line impedance.

The measurement can be started or stopped by the **START/STOP** key

The elapsed time is continuously indicated

Test Results

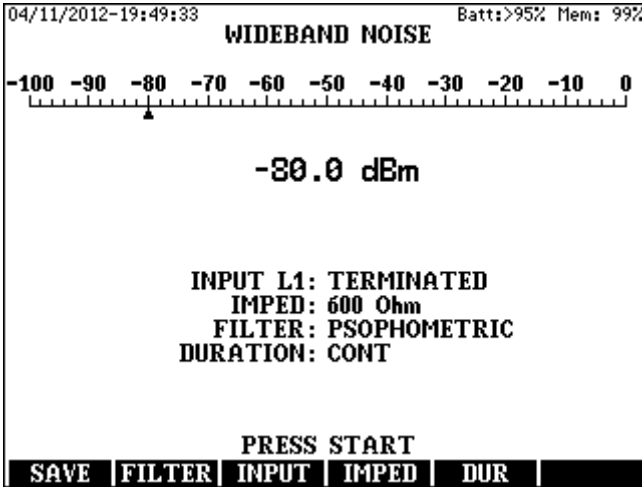
The form of test result depends on the selected measuring time.

In case of:

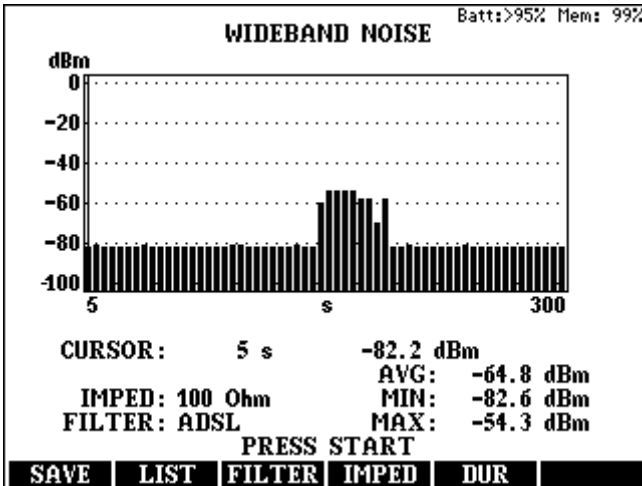
1sec to 1 min the form is numeric and quasi analog

Over 1min histogram and list form

When the selected measuring time is shorter than 5 minute the following display appears:



When the selected measuring time is 5 minute or longer the test result is displayed in histogram form but pressing the **LIST (F2)** key the result appears in numeric form. To get back to graphic form press **ESC**



4.12 Impulse Noise Measurement

Impulse noise is a non-stationary cross talk from electromagnetic events in the vicinity of phone lines. Examples of impulse noise generators are as diverse as the opening of refrigerator door (the motor turns on/off), control voltages to elevators (phone lines in apartment buildings often run through the elevator shaft) and ringing of phones on lines sharing the same binder.

Any burst of noise that produces a voltage exceeding the power level of the background noise by more than 12dB is declared impulse noise.

In impulse noise-measuring mode ELQ 30A operates as an impulse counter. An impulse is counted when the received noise signal exceeds a preset threshold for more than 500 ns. (The recommended threshold setting is 14 dB above the measured wideband noise level.)

The selectable measuring times:

- 1,5,10, 30 sec
- 1, 5, 10, 30 min
- 1, 2, 4, 8, 12, 24, 48, 72 hours

The noise impulses may reset the VDSL modems spoiling the data transfer for a longer time. The impairment of communication does not depend only on the impulse number but also on the time distribution of impulses. The same number of noise impulses may cause:

One reset if they come in one single burst

Numerous resets if they come in different times

ELQ 30A displays the counted impulses in histogram form with 60 time slots providing information about the time distribution.

Test Procedure

- Enter **SINGLE END/IMPULSE NOISE** mode
- Press the **TRESH (F2)** key and enter the required threshold level
- Press the **INPUT (F3)** key and enter the required line termination.
- Press the **IMPED (F4)** key and enter the required line impedance
- Press the **DUR (F5)** key and enter the required Measurement time
- Start counting by the **START/STOP** key

Test Results

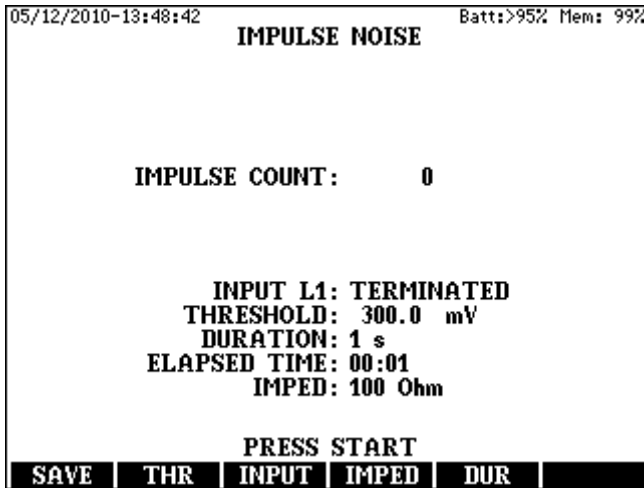
The form of test result depends on the selected measuring time.

In case of:

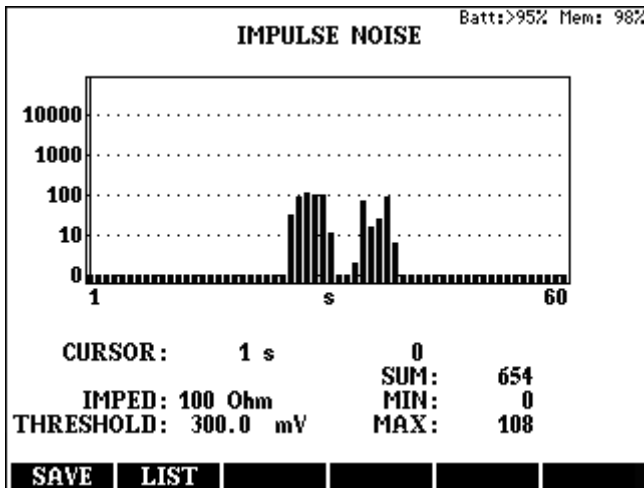
1sec to 30 sec the form is numeric and quasi analog

Over 30 sec histogram and list form

When the selected measuring time is shorter than 1 minute the following display appears:



When the selected measuring time is one minute or longer the test result is displayed in histogram form but pressing the **LIST (F2)** key the result appears in numeric form. To get back to graphic form press **ESC**



4.13 Micro Interruption Measurement

Principles of Operation

A micro interruption is a temporary line interruption due to external mechanical action on the copper wires constituting the transmission path, for example, at a cable splice. Splices can be hand-made wire-to-wire junctions, and during cable life oxidation phenomena and mechanical vibrations can induce micro interruptions at these critical points.

The effect of a micro interruption on the transmission system can be a failure of the digital transmission link. In the presence of an interruption of specified maximum length the xDSL modem may reset.

ELQ 30A detects the micro interruptions using 1020 Hz test tone. An interruption is detected when the level of the received test tone drops below a designated threshold for more than 0.6 ms.

The detected interruptions are divided into five categories by duration:

- 0.6 ms to 3 ms
- 3ms to 30 ms
- 30 ms to 300 ms
- 300 ms to 1min
- >1min

The threshold level is adjustable in steps to the values 3, 6, 10 and 20 dB below the normal test signal level. The measuring time is adjustable between 4 min and 72 hours.

ELQ 30A provides detailed information about

- Number of interruptions divided into five categories.
- Relative duration of interruptions.
- Error seconds.
- Time distribution of interruptions in 240 time slots.

The interruption Measurement can be performed in:

- Single Ended mode with loop back using the same ELQ 30A for transmitting and receiving.
- End to End mode using two ELQ 30A-s connected to the ends of the tested pair. In this case one of them transmits a test tone the other one receives and evaluates it.

Settings Before Interruption Measurement

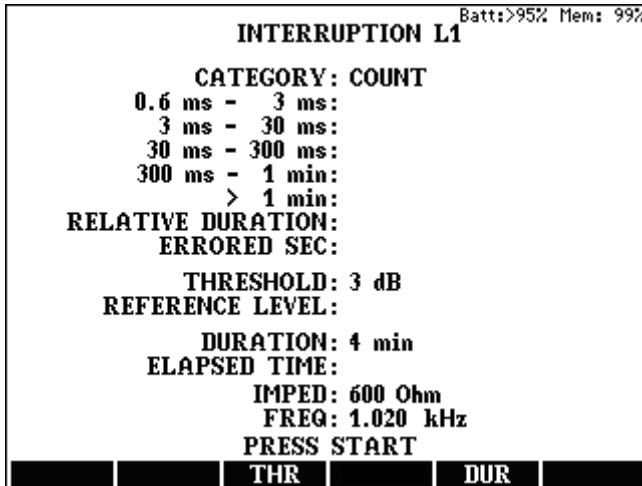
To save the battery life ELQ 30A has a power down facility switching the instrument off after a preset time. Therefore in case long time interruption Measurement ELQ 30A should be used with mains adapter. If it is not possible then the power off function should be disabled before starting a long time test like interruption

Disabling of power down function

- Enter the **SETTINGS & OPERATOR** mode
- Enter the **POWER OFF TIME** function
- Enter the **OFF** option

Test Procedure

- Enter **INTERRUPTION** mode
(Doing so the 1020 Hz test tone automatically appears on connector L2)



Measuring time setting

- Press the **DUR (F5)** key and select the required measuring time by the vertical cursors and press **ENTER**.

Threshold level setting

Press the **THRESH (F3)** key and select the required threshold level by the vertical cursors and press **ENTER**.

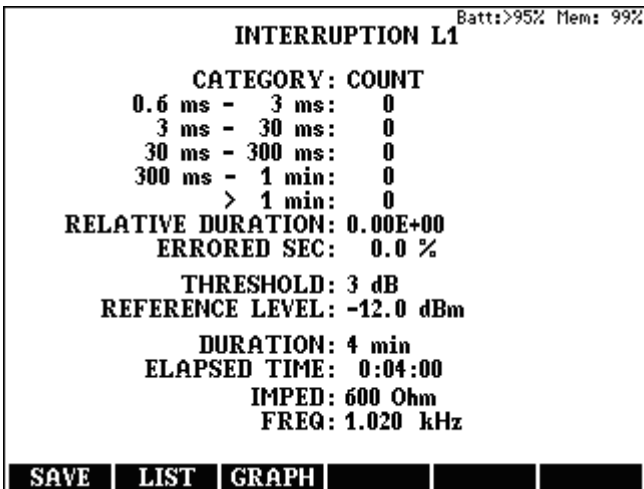
Having the settings finished start the Measurement by pressing the **START/STOP** key.

Measuring process

The measuring process consists of two parts.

- First when the Measurement is started ELQ 30A measures the level of the received test tone and stores that value as **REFERENCE LEVEL** of the Measurement.
- Having the **REFERENCE LEVEL** stored ELQ 30A starts to count interruptions.

The following picture is displayed during and after the Measurement keeping the user informed about the actual count of interruptions and the measuring time left:



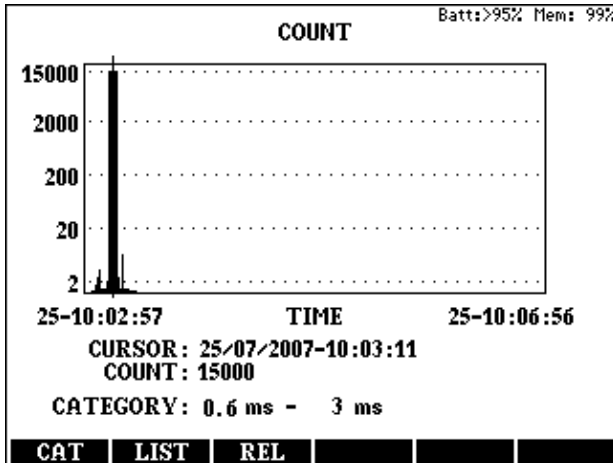
When the Measurement is ready the user can get immediate information about the:

- Number of interruptions divided into five categories.
- Relative duration of interruptions.
- Error seconds.

In addition ELQ 30A provides detailed information about the time distribution of interruptions. The measuring time is divided into 240 time slots.

Number of interruptions in a time slot

Pressing the **GRAPH (F3)** key the number of interruptions appears in graphic form. The displayed picture shows the time distribution for a selected category as a vertical bar graph.



- To see the count of interruptions in a given time slot, use the horizontal cursors.
- To change the category, press the **CAT (F1)** key select the required category with the vertical cursors and press **ENTER**
- To see the count of interruptions in numeric form, press the **LIST (F2)** key. The appearing list shows the count for each category and time slots together

TIME	COUNT				
	0.6 3	3 30	30 300	300 1min	>1min
25-10:25:17	0	0	0	0	0
25-10:25:18	0	0	0	0	0
25-10:25:19	0	0	0	0	0
25-10:25:20	0	0	0	0	0
25-10:25:21	0	0	0	0	0
25-10:25:22	0	0	0	0	0
25-10:25:23	0	0	0	0	0
25-10:25:24	0	0	0	0	0
25-10:25:25	0	0	0	0	0
25-10:25:26	0	0	0	0	0
25-10:25:27	0	0	0	0	0
25-10:25:28	0	0	0	0	0
25-10:25:29	0	0	0	0	0
25-10:25:30	0	0	0	0	0
25-10:25:31	0	0	0	0	0

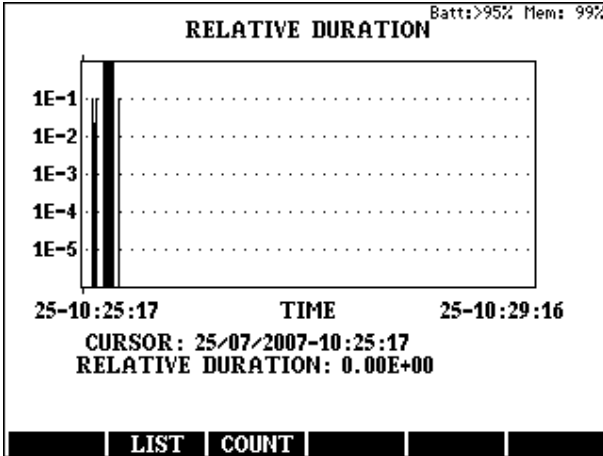
↓

| GRAPH | REL |

To return press **GRAPH (F2)**

Relative duration of interruptions in a time slot

Pressing the **REL (F3)** key the test relative duration of interruptions appears in graphic form. The displayed picture shows the time distribution as a vertical bar graph.



- To see the relative duration in a given time slot, use the horizontal cursor keys.
- To see the relative duration of interruptions in numeric form, press the **LIST (F2)** key.

RELATIVE DURATION Batt:>95% Mem: 99%

TIME	RELATIVE DURATION
25-10:43:44	0.00E+00
25-10:43:45	0.00E+00
25-10:43:46	0.00E+00
25-10:43:47	0.00E+00
25-10:43:48	0.00E+00
25-10:43:49	0.00E+00
25-10:43:50	0.00E+00
25-10:43:51	0.00E+00
25-10:43:52	0.00E+00
25-10:43:53	0.00E+00
25-10:43:54	0.00E+00
25-10:43:55	0.00E+00
25-10:43:56	0.00E+00
25-10:43:57	0.00E+00
25-10:43:58	0.00E+00

GRAPH | COUNT |

To return press **GRAPH (F2)**

Storage of test results

The measuring results can be stored by pressing the **SAVE (F1)** key when the short form test result picture is displayed. For the sake of economical utilization of memory the resolution of stored results depends on the count of interruptions as it is shown in the next table:

Count range	Resolution
0 to 15.....	1
15 to 20.....	5
20 to 150.....	10
150 to 200.....	50
200 to 1500.....	100
1500 to 2000.....	500
2000 to 15000.....	1000

4.14 Echo Test

There are several reasons for the undesirable quality degradation and the appearance of audible echoes is one of them. This kind of quality degradation is inherent in the network equipment and the end-user phone devices.

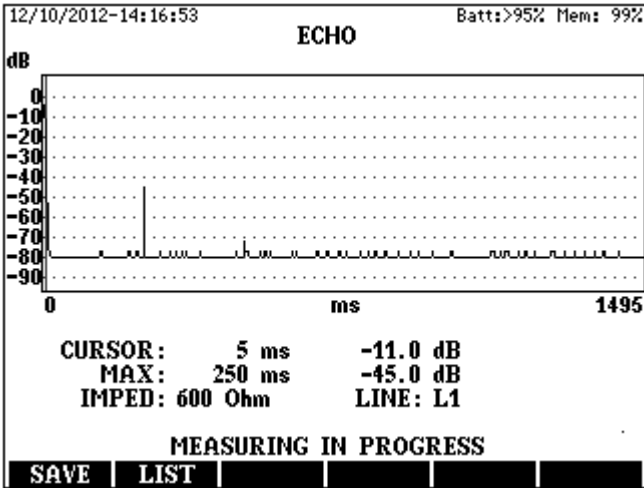
For the test of the disturbing echoes ELQ 30A transmits short ~1020 Hz signal packets with proper amplitude shaping and measures the amplitude and the traveling time of the reflected signal.

Measuring ranges:

- Traveling time range: 15 to 2500 ms
- Time resolution: 5 ms
- Amplitude indication: down to -60 dBm

Test Procedure

- Enter **SINGLE END/ECHO TEST** option
- Select and enter the required impedance



The measurement can be started or interrupted by the **ST/SP** key

Test Results

The test results are displayed in graphic form during the measurement. To get numeric form:

- Interrupt the measurement by the **ST/SP** key,
- Press the **LIST (F2)** key and the result appears in numeric form.

Having the measurement completed and stopped the result can be saved with the **SAVE (F1)** key.

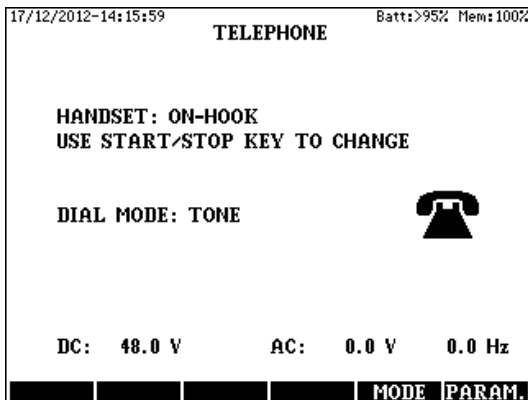
4.15 Telephone Simulator

ELQ 30A in this mode is able to:

- Receive a call sent by another user
- Send a test call to another user and talk with him
- Allow a conversation between the two users
- Measure the battery and ringing voltage & ringing frequency

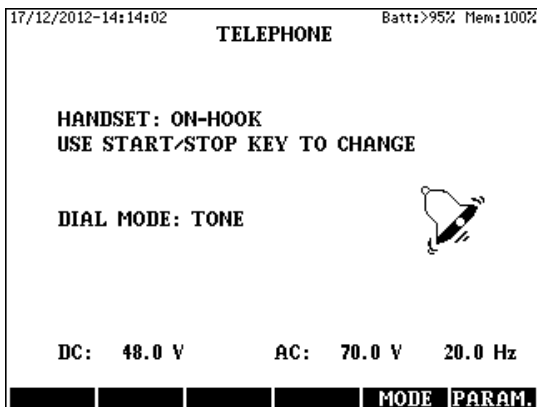
Test Procedure

Enter **SINGLE END/TELEPHONE SIMULATOR** option



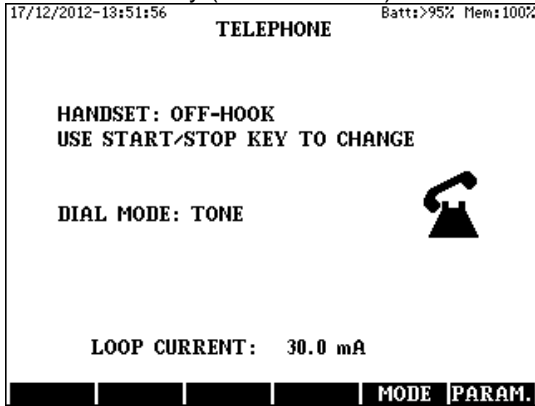
The default is the call waiting (On hook state)

- In this state ELQ 30A is waiting for a call from the other end of the line and measures the ringing voltage and frequency.



To receive the call

- Press the **START/STOP** key (Off hook state)



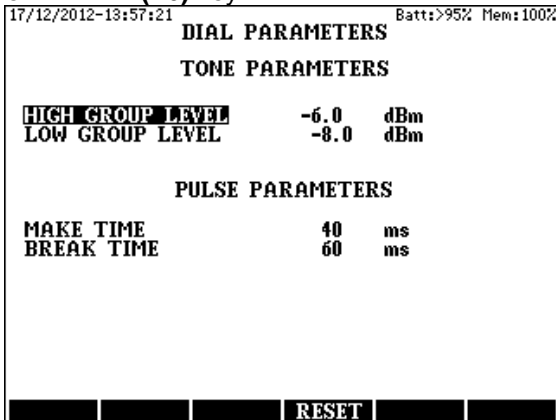
- Having the conversation finished press the **START/STOP** key again

To make a call

- Select the required dial mode with the **MODE (F5)** key
- Press the **START/STOP** key (Off hook state)
- Type in the required phone number.
- Having the conversation finished press the **START/STOP** key again

Modification of DTMF or pulse parameters

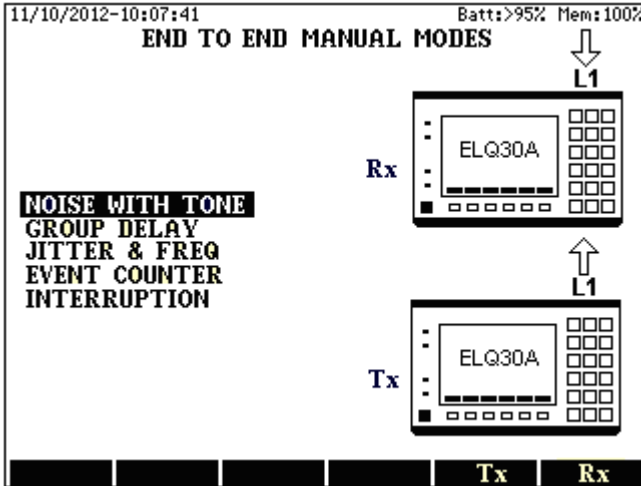
- Press the **PARAM. (F6)** key



- Do the modification
- Press **ESC**
- To return to the standard values press the **RESET (F4)** key

5 MANUAL END TO END TESTS

Enter the **MANUAL MODES: END TO END** option of **MAIN MENU**.
 Having the **ENTER** key pressed the following display appears:

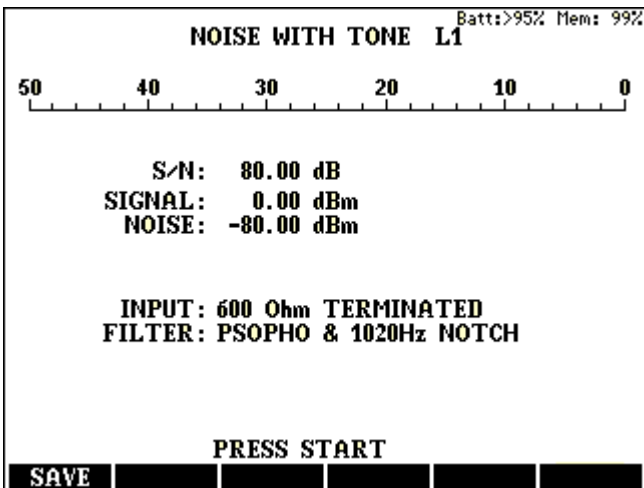
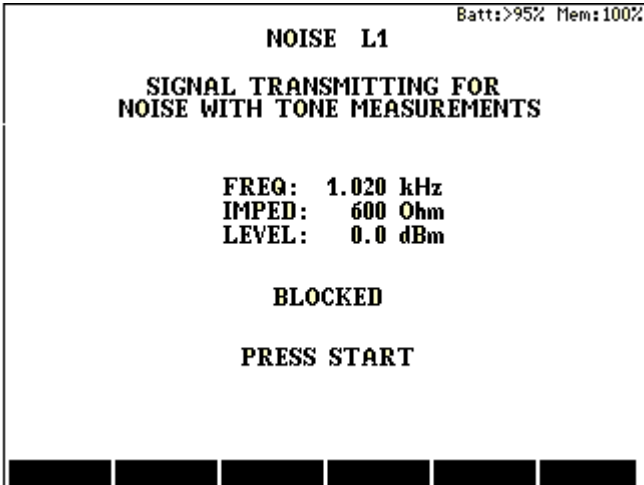


5.1 Noise with Tone Measurement

The noise with tone measurement needs two ELQ 30A instruments connected to the ends of the tested pair. One of them transmits 1020 Hz conditioning tone the other one receives and evaluates it.

Test Procedure

- Select the **NOISE WITH TONE** option with the \uparrow/\downarrow keys
- Select the function by pressing the **Tx (F5)** or **Rx (F6)** key



The measurement can be started or interrupted by the **ST/SP** key.

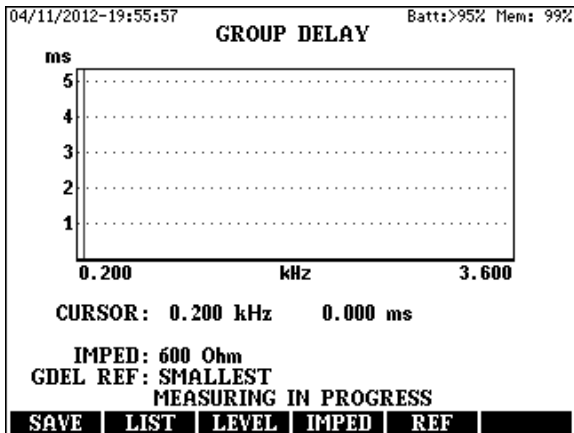
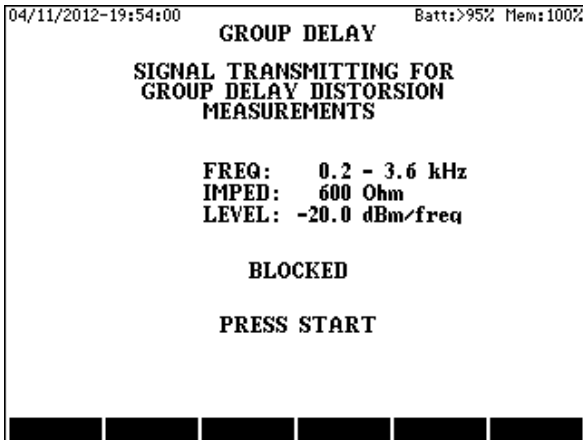
5.2 Group Delay Distortion Measurement

ELQ 30A applies the multi tone test method described in the recommendation ITU-T O.81 Appendix I

The group delay distortion measurement needs two ELQ 30A instruments connected to the ends of the tested pair. One of them transmits a test tone the other one receives and evaluates it. ELQ 30 A performs Group delay distortion and level measurements simultaneously:

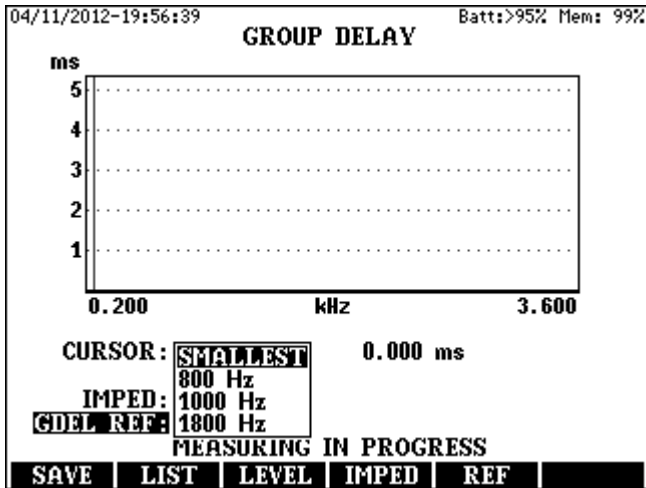
Test Procedure

- Select the **GROUP DELAY** option with the \uparrow/\downarrow keys
- Select the function by pressing the **Tx (F5)** or **Rx (F6)** key



To change the reference value

- Press the **REF (F5)** key
- Select the required option with the \uparrow/\downarrow keys
- Press **ENTER**



The measurement can be started or interrupted by the **ST/SP** key.

The display can be changed between group delay and level measurement with the **F3** key

Test Results

The test results are displayed in graphic form during the measurement. To get numeric form:

- Interrupt the measurement with the **ST/SP** key,
- Press the **LIST (F2)** key and the result appears in numeric form.

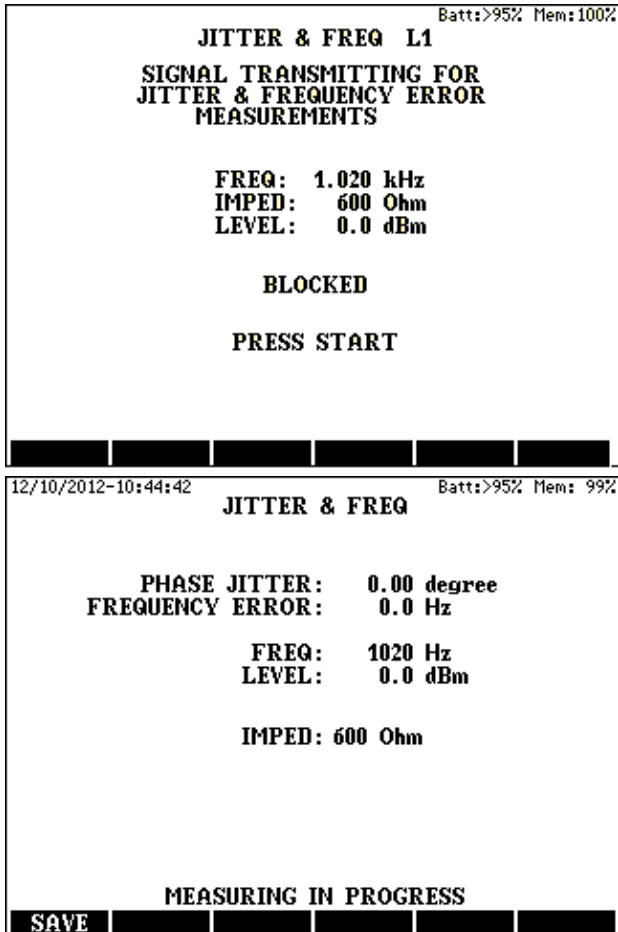
Having the measurement completed and stopped the result can be saved with the **SAVE (F1)** key.

5.3 Phase Jitter & Frequency Error Measurement

The jitter and frequency error measurement needs two ELQ 30A instruments connected to the ends of the tested pair. One of them transmits a jitter free quartz accurate 1020 Hz test tone the other one receives and evaluates it. ELQ 30A performs the two measurements simultaneously according to rec. ITU-T O.91

Test Procedure

- Select the **JITTER & FREQU** option with the \uparrow/\downarrow keys
- Select the function by pressing the **Tx (F5)** or **Rx (F6)** key



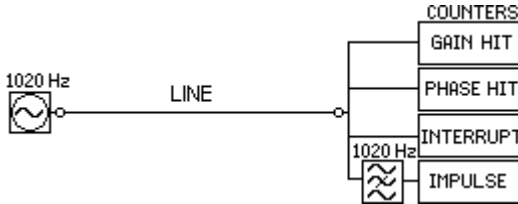
The measurement can be started or interrupted by the **ST/SP** key.

5.4 Simultaneous Event Counter Mode

The event test needs two ELQ 30A instruments connected to the ends of the tested pair. One of them transmits a test tone the other one receives it and simultaneously counts the number of events like:

- Amplitude hits (described in rec. ITU-T O.95)
- Phase hits (described in rec. ITU-T O.95)
- Interruptions (described in rec. ITU-T O.61)
- Noise impulses (described in rec. ITU-T O.71)

Measuring arrangement:



Test signal: 1020 Hz

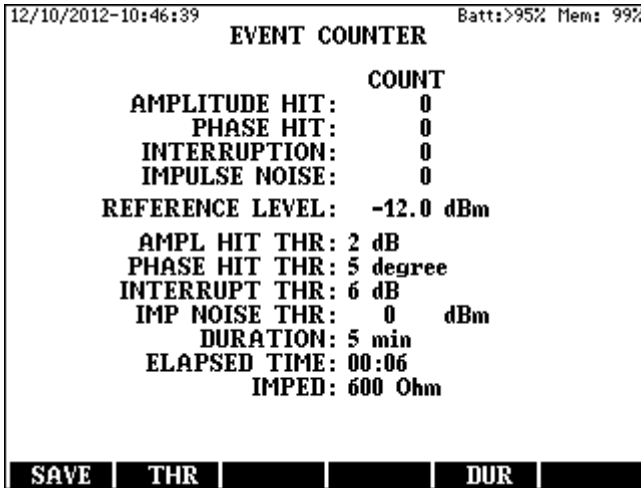
Measuring times: 5, 15, 30, 60 min

Maximum count: 65000 for each counter

Test Procedure

- Select the **EVENT COUNTER** option with the \uparrow/\downarrow keys
- Select the function by pressing the **Tx (F5)** or **Rx (F6)** key





Tasks at the receiver end

- Press the **DUR (F5)** key and enter the required measuring time.
- Press the **THR (F2)** key and enter the required thresholds.
- Start the measurement with the **ST/SP** key

The measuring process

The process consists of two parts.

- First when the measurement is started ELQ 30A measures the level of the received test tone and stores that value as **REFERENCE LEVEL**.
- Having the **REFERENCE LEVEL** stored ELQ 30A starts to count the events. The elapsed time is continuously indicated.

Having the measurement completed and stopped the result can be saved with the **SAVE (F1)** key.

Important Note:

The use of mains adapter is recommended to avoid the discharge of battery during a long time test!

5.5 Interruption Measurement

See section 4.14

6 TDR MEASUREMENTS

6.1 Principles of Operation

ELQ 30A in Time Domain Reflectometer (TDR) mode utilizes the radar principle. A measuring pulse is transmitted down a cable. When that pulse reaches the end of the cable or a fault along the cable, a certain part or all the pulse energy is reflected back to the instrument.

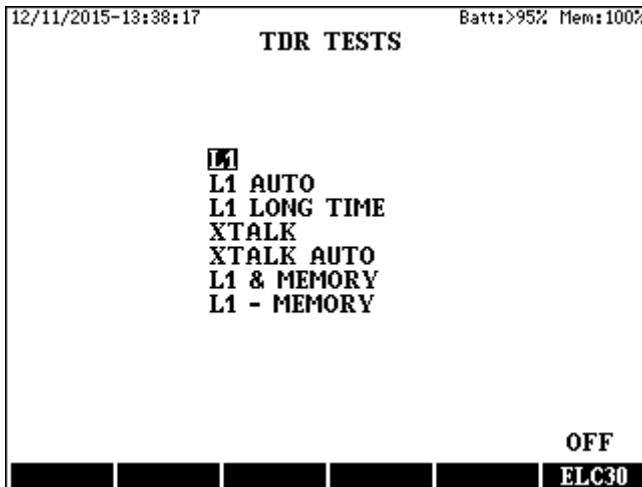
ELQ 30A measures the time taken by the pulse to travel down the cable, see the problem, and reflect back. Then converts this time to distance and displays the information as a waveform. The displayed waveform shows all impedance discontinuities along the cable.

The amplitude of any reflection is determined by the degree of the impedance change.

Distance to fault is displayed on the screen after the cursor is positioned to the start of the reflected fault pulse

6.2 Mode Selection

- Enter the **TDR TESTS** option of **MAIN MENU**



ELQ 30A provides five manual and two automatic measuring modes

6.3 Manual Measuring Modes

Investigation of a pair (L1 mode)

Transmission and reception of pulses takes place over the L1 terminal ELQ 30A performs a sequence of repeated Measurements. The last result is graphically displayed and the previous ones are cleared. (The most frequently used basic mode of operation)

Long time Measurement of a pair (L1 LONG TIME mode)

This measuring mode can be used to locate loose contacts. ELQ 30A performs a sequence of repeated Measurements in this mode as well but the results are not cleared. All the results are displayed together. If the features of the tested pair change during the Measurement the waveform becomes thick at the place of change.

Location of cross talk points (XTALK mode)

The measuring pulse is transmitted via L2, and the reflected pulses are received via L1.

Comparison with memory (L1& MEMORY and L1-MEMORY modes)

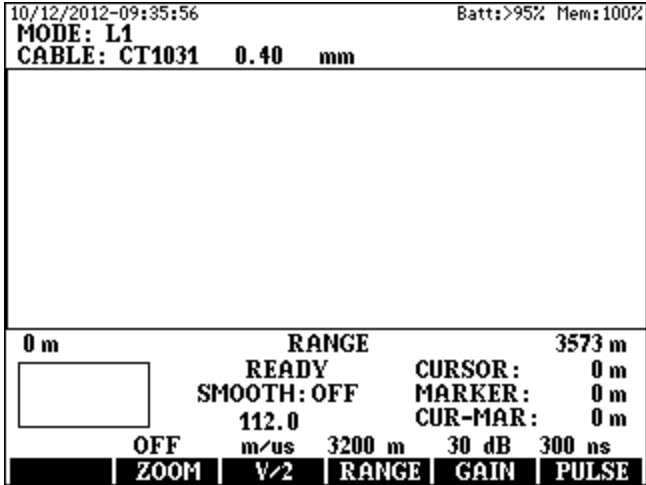
L1 & MEMORY The actual trace and a stored one are displayed together.

L1- MEMORY The difference between them is displayed.

A waveform stored in memory can be used for comparison of cable conditions before and after a critical period or a repair job.

6.3.1 Settings before Start

- Enter the required manual measuring mode of **TDR TESTS** menu
In case of mode **L1** selection the following display appears



For the proper evaluation of the obtained waveform we have to know

- the propagation velocity of the tested cable

For the proper initial settings of test parameters we have to know

- the gauge and
- the approximate length of the tested cable

The propagation velocity and the gauge of different cable types can be taken from the cable library of ELQ 30A.

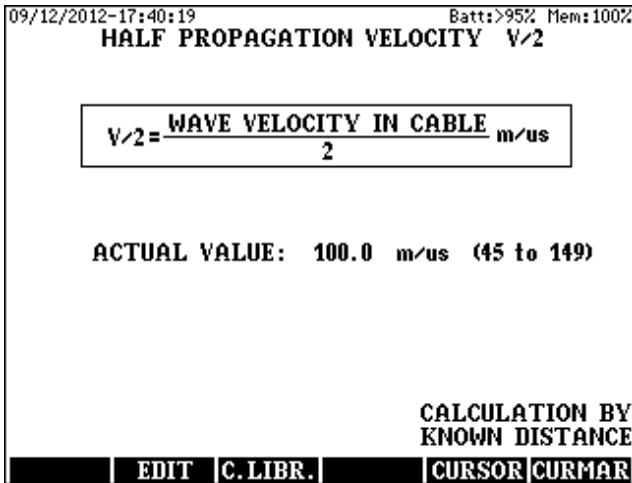
Range selection

- Press the **RANGE (F4)** key and select the measuring range definitely covering the length of cable and press **ENTER**

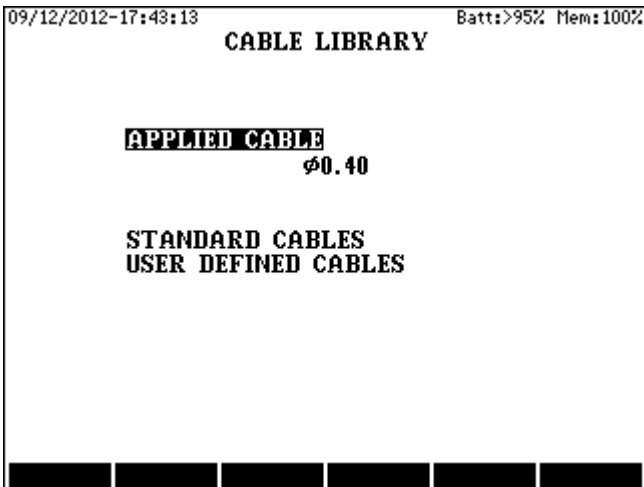
Cable Type selection

The actually valid cable type can be seen on the upper field of display. Parameters belonging to that type will be used for the subsequent measurements. To change the cable type:

- Press the **V/2 (F3)** key



- Call the cable library by pressing the **C.LIB (F3)** key



- Enter the new type
- Press **APPLY**
- Press **ESC**

6.3.2 Running the Test

Having mode, range and cable-type set the measurement can be started by pressing the **START/STOP** key.

The measurement is running repeatedly until a following **START/STOP** keystroke.

- The last obtained waveform is displayed in all measuring modes except **L1 LONG TIME** mode. To save battery life, the measurement is automatically stopped after one minute elapsed time.
- In **L1 LONG TIME** mode all the obtained waveforms are displayed together showing the intermittent faults. In this mode there is no time out.

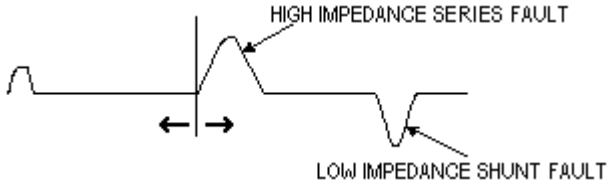
Balance Adjustment

Adjust the rotary **BALANCE** control to minimize the transmit pulse at the start of waveform. (In **XTALK** mode, the balance control is not effective.)

6.3.3 Waveform Evaluation

Reading Distance to Fault

After the measurement process is terminated, move the red cursor with the horizontal cursor keys to the start point of the reflected pulse.



The displayed value of the cursor shows the distance to fault. Remember to deduct the length of the test leads.

Waveform Expansion (ZOOM)

The waveform can be shown in more detail around the cursor line by using the **ZOOM** facility. The amount of horizontal expansion can be selected as follows:

- Using the ← → keys move the cursor to the point around which you want to expand the waveform
- Press the **ZOOM (F2)** key and select the required value with the ↑↓ keys

On the down left corner of the display there is a “ZOOM INFO” showing information about the non visible part of trace if the ZOOM is on

Use of Marker

The marker appears as a vertical green line and can be placed to any selected point of the waveform. Displayed are: the position of marker, the position of cursor, further the true distance from marker to cursor.

To measure the distance between any two points, the marker should be used as follows:

- Move the cursor to the point from which the distance is to be measured and set the marker by pressing **MARKER**.
- Move the cursor to the point to which the distance measurement is to be carried out.

The distance between these points is directly shown by the display.

The Smoothing Function

Because of the attenuation losses, the reflection from a fault long way down the cable may be much smaller than a regular reflection from a nearby discontinuity. The amplitude display of near reflections can be reduced by the smoothing function as follows:

- Press the **SMOOTH** key
- Select the required reduction with the ↑↓ keys

6.3.4 Location of Cross Talk Points

The measurement

In **XTALK** mode one of the pairs is connected to the L1 sockets, and the other one to the L2 sockets. The measuring pulse is transmitted on L2 socket the reflected pulses are received on L1. This mode is typically used for locating splits and resplits. The steps of measurement are similar for the L1 mode. (The **BALANCE** control is not operational in this mode.)

6.3.5 Comparison to Stored Result

Waveforms stored in memory can be used for comparison of the cable conditions before and after a critical period, or before and after a repair job. The stored waveform and the recently obtained waveform can only be compared if the main parameters are the same. As the main parameters are stored together with the waveform, the actual measurement must be performed with the stored settings (V/2, RANGE, PULSE WIDTH, GAIN). Accordingly, in this mode, the controls of the above mentioned parameters are not operational. There are two methods of comparison:

Comparison in L1 & MEMORY mode

In this mode, the stored and the actually obtained waveforms are displayed together (the stored is brown the actually obtained is blue)

Measurement steps:

- Enter the **L1 & MEMORY** option of **TDR MENU** The list of stored waveforms is now displayed.
- Select the memory location containing the stored waveform to be used for comparison and press **ENTER**.
- Start the measurement by pressing the **START/STOP** key.
- For evaluation, the **CURSOR**, **MARKER** and **ZOOM** facilities can be used as in the single pair investigation.

The vertical position of stored Waveform can be shifted with the $\uparrow \downarrow$ keys.

Comparison in L1 - MEMORY mode

In this mode, the difference between the obtained and the stored Waveform is displayed. Measurement steps:

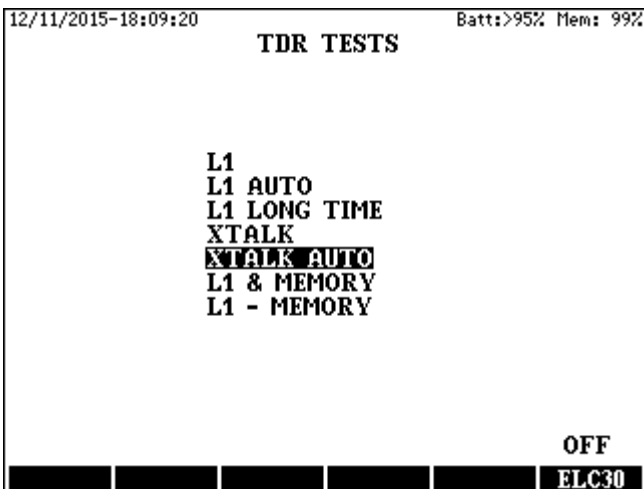
- Enter the **L1 - MEMORY** option of **TDR MENU**. The list of stored waveforms is now displayed.
- Select the memory location containing the stored waveform to be used for comparison and press **ENTER**.
- Start the measurement by pressing the **START/STOP** key.

For evaluation, the **CURSOR**, **MARKER** and **ZOOM** facilities can be used as in the single pair investigation.

6.4 Automatic Measuring Modes

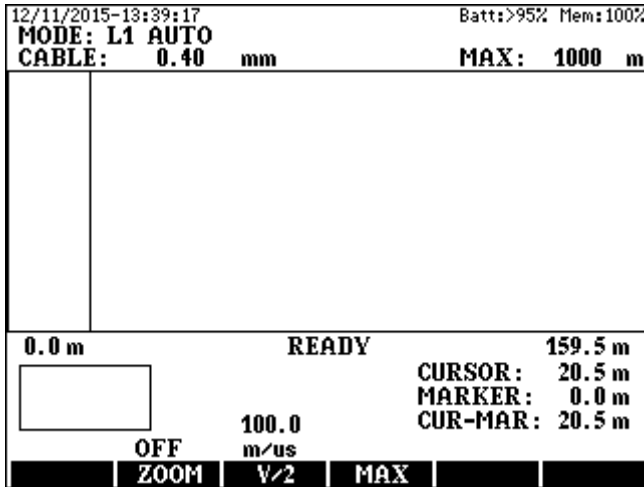
In auto configuration TDR mode ELQ 30A can detect one or more reflected pulses and preset the best setup for each pulse separately

Auto configuration mode can be selected both for single and double pair measurement

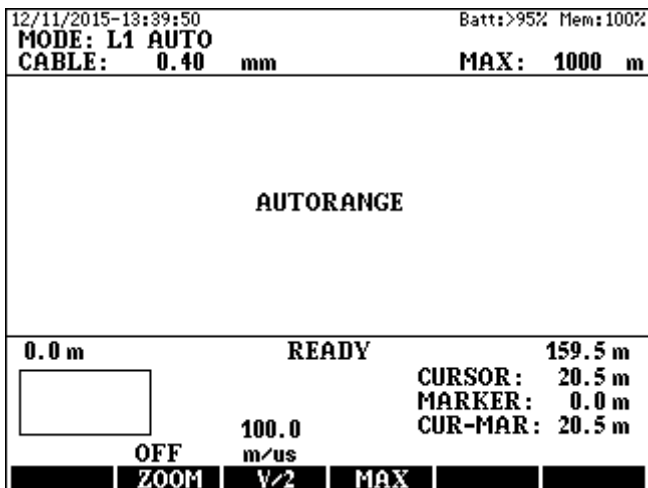


6.4.1 Start the Measurement

After the mode selection one of the auto mode displays appears

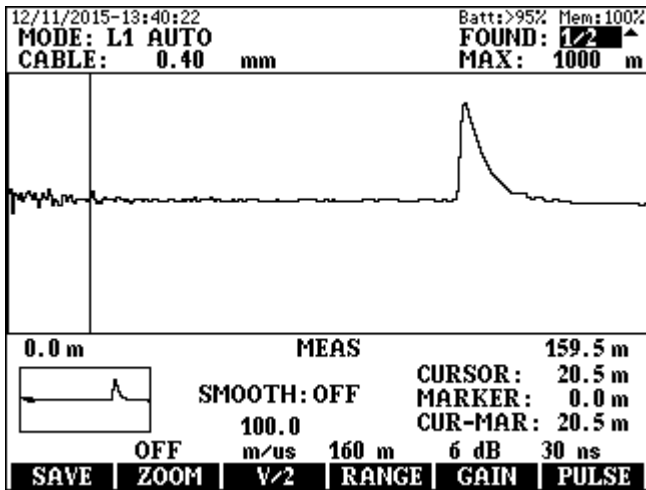


The reflected pulse detection can be started with the **START/STOP** key. The detection process may take several seconds depending on the features of the tested line.



6.4.2 Test Results

When the detection process completed the result display appears showing the first reflected pulse and the number of detected pulses.



The further reflected pulses can be selected with the $\uparrow\downarrow$ keys

The Alteration of Test Setup

If necessary the obtained waveform can be improved by the alteration of the automatically preset RANGE, GAIN and PULSE values.

6.5 TDR application guide

6.5.1 General Hints

Reflections can be classified to fall into two groups:

- Regular reflections
- Reflections from faults (irregular reflections)

Regular reflections

Even faultless pairs may produce reflections caused by inherent discontinuities such as joints or cable type changes.

Reflections from faults

A faulty pair produces regular reflections and, in addition, reflections from the fault. Because of the attenuation losses, the reflection from a fault long way down the cable may be much smaller than a regular reflection from a nearby discontinuity.

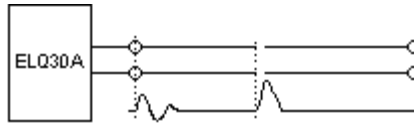
A suitable method to distinguish regular and irregular reflections is to compare the faulty cable with a good one. By using the **L1 & MEMORY** method, the regular reflections caused by the common features of the two pairs can be separated from reflections caused by faults.

- In telephone cables there are several pairs of conductors. The physical length of the pairs depends on their position in the cable, the length increasing with the distance of the layer from the center. Consequently, the physical length of pairs can be longer than the cable length, and the propagation velocity (V) may be different for different layers. Therefore, in case of comparative tests, the two pairs compared should be in the same layer.
- If there is more than one fault, the first one may reflect so much from the pulse energy that the subsequent fault may not be seen. Therefore, having located and eliminated the first fault, the cable section following the fault should be tested again.

6.5.2 Typical Waveforms

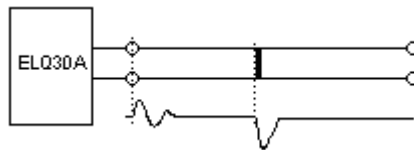
Open circuit (series faults)

The reflection is a positive (upward going) pulse. No reflected pulse from the far end.



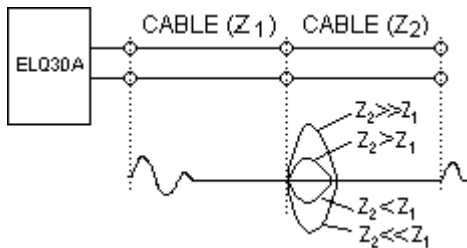
Short circuit (shunt fault)

The reflection is a negative (downward going) pulse. No reflected pulse from the far end.



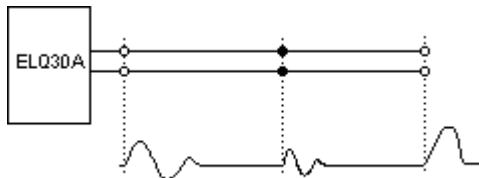
Change of cable type (mismatch)

The amplitudes of the reflected pulses are determined by the degree of impedance changes.



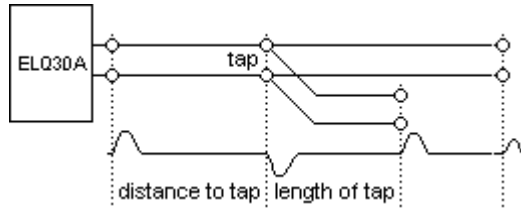
Joints (splices)

The joints produce 'S' shaped reflections.



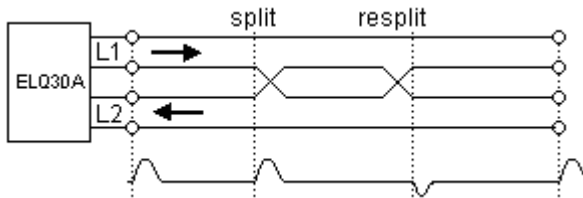
Taps (tee joints)

A tap produces two pulses, one at the beginning and the other at the end of the tap.



The troubleshooting may be difficult if the tested pair is tapped at many points. In this case, moving from tap to tap the test should be progressively done

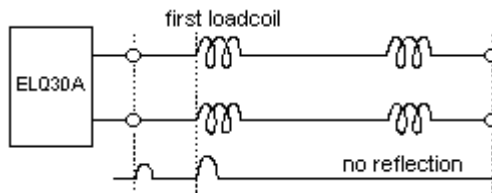
Splits and resplits



Splits and resplits produce cross talk.

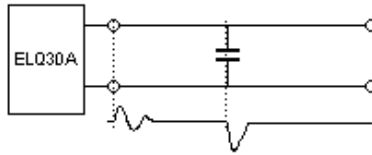
Loading coils

Loading coils produce positive (upward going) reflections. Generally, TDR's cannot 'see' beyond the first loading coil. For fault location beyond the loading coil, the ELQ30A should be connected to another point following the coil.



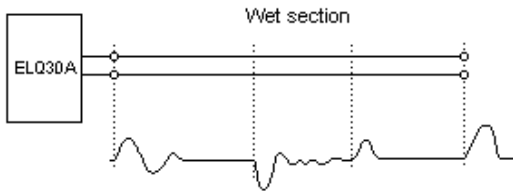
Capacitance network

The reflection is negative (downward going pulse).



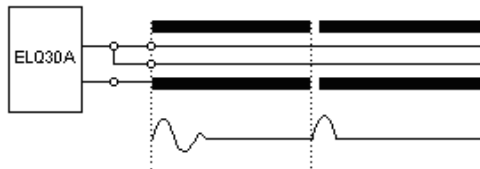
Wet section

The presence of water causes a capacitance increase. Therefore, there are two pulses: one from the beginning, the other from the end of the wet section.



Open sheath

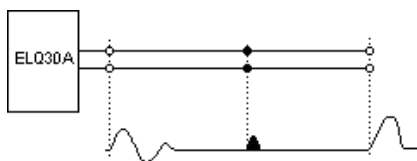
If the metallic sheath of the cable is broken, the position of the break can be located by connecting the test leads to the shield and to as many conductors as possible.



Lose Contacts

The location of lose contacts can be found with Long Time test.

If the features of the tested pair change during the Measurement the waveform becomes thick at the place of change.



6.5.3 Automatic velocity constant calculation

The unknown propagation velocity constant can be determined in the following cases:

- The length of the cable is known
- The distance to a known point is available (e.g. join box, change of cable-type etc.)
- A sample of the same cable is available with a known length
- The distance between two points is known.

When the cable length or the distance to a known point is available

- Connect the cable to the **L1** terminals and obtain a waveform
- Stop the measurement with the **START/STOP** key
- Place the cursor to the start point of the pulse reflected from the known point.
- Press the **V/2 (F3)** key
- Press the **CURSOR (F5)** key
- Type in the known distance
- Pressing the **ENTER** key, the proper value will be set automatically

When the distance between two points is known

- Connect the cable to the **L1** sockets and obtain a waveform
- Stop the measurement with the **START/STOP** key
- Place the cursor to the starting point of the pulse reflected from the first known point, and set the marker by pressing **ENTER**
- Place the cursor to the starting point of the pulse reflected from the second known point
- Press the **V/2 (F3)** key
- Press the **CUR-MAR (F6)** key
- Type in the known distance between the two points.
- By pressing the **ENTER** key, the proper value will be set automatically.

7 AUTOMATIC SINGLE ENDED TEST SEQUENCES

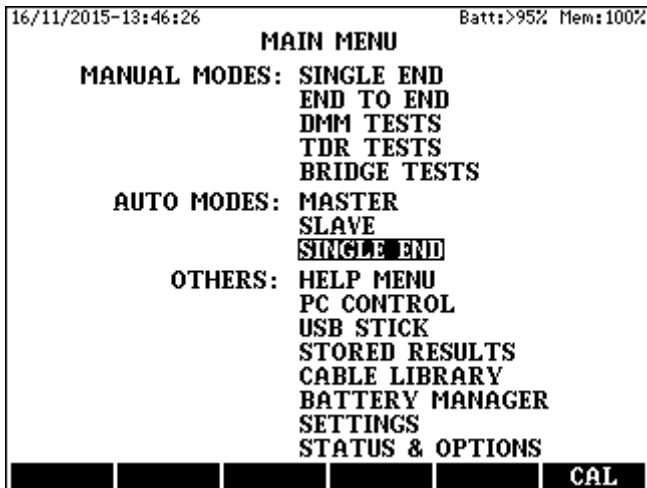
7.1 Mode Selection

ELQ 30A provides single sided test sequences to estimate the data transfer capacity of tested lines used for different xDSL systems. The far end of the tested line should be unterminated.

Tolerance masks of cable parameters as Loss, LCL, Return Loss, Impedance, and the principal system parameters are pre-programmed for different xDSL systems

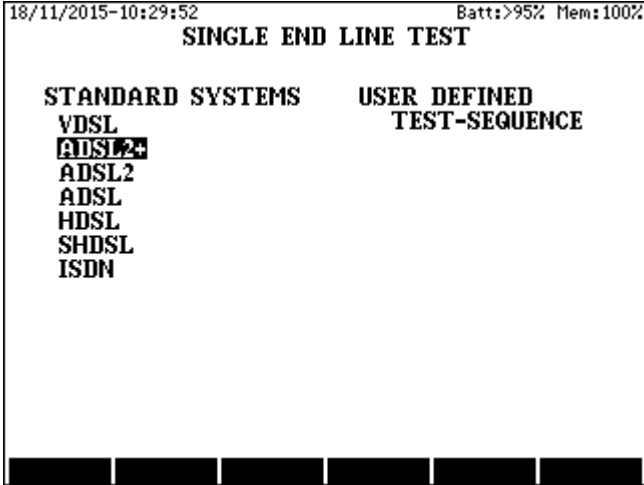
After selecting the xDSL system ELQ 30A launches an automatic test sequence containing unilateral measurements

- Enter the **AUTO MODES/SINGLE END** option of **MAIN MENU**

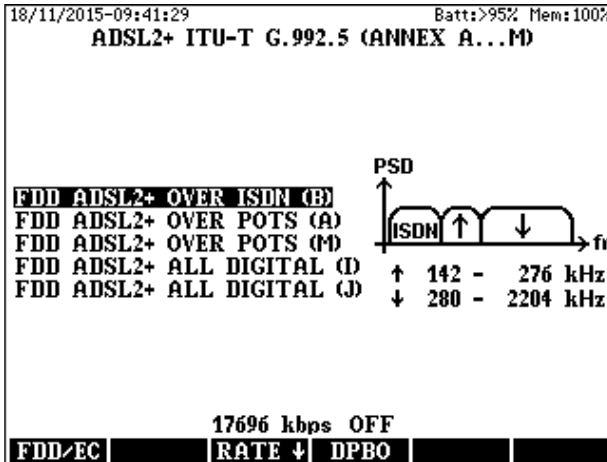


7.2 Preparing the Program

When **SINGLE END** mode is selected the **SINGLE END LINE TEST** menu appears providing xDSL system dependent automatic test sequence options.



- Enter the required system group (E.g. ADSL2+) and then the ADSL2+ submenu appears



- Draw the highlight on the required system with the \uparrow/\downarrow keys

- Select the required line spectrum with the **FDD/EC (F1)** key
- Press the **RATE ↓ (F3)** key and enter the required bit rate
- In case DPBO is necessary press the **DPBO (F4)** key and enter the required ESEL and MUS values using the corresponding keys
- When the setting of test parameters is completed press **ENTER** and then the automatic program start display appears offering offers three program options
SHORT (loss and noise Measurement)
LONG (Measurement of all characteristics except NEXT and FEXT)
FREE (user selected Measurements)
 The program option can be selected with the function keys **F1** to **F3**
 Having the required system entered the start display appears

18/11/2015-10:49:46 Batt:>95% Mem:100%

SINGLE END LINE TEST

SYSTEM: G.992.5.B FDD
PROGRAM: STANDARD FREE

TEST		
LOSS	L1	#
NOISE	L1	#
RET. LOSS	L1	#
IMPEDANCE	L1	#
BALANCE	L1	#
NEXT	L2→L1	#

MEASURING TIME:
02:11

ELQ30A AT
CENTRAL END

FREE
SHORT
LONG
ELQ30A
PARAM.

In case of ADSL or VDSL systems the position of ELQ 30A should be declared. It can be changed with the **ELQ30A (F5)** key.

7.3 Running the Program

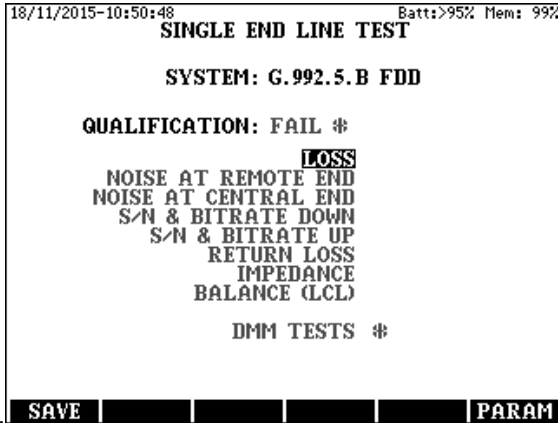
The program can be started or aborted by the **START/STOP** key

Important note:

Before starting the program be sure that the far end of the tested line is unterminated!.

Short Form Test Result

When the test program is completed a short form result page appears with immediate **PASS/FAIL** information and with the list of detailed result pages

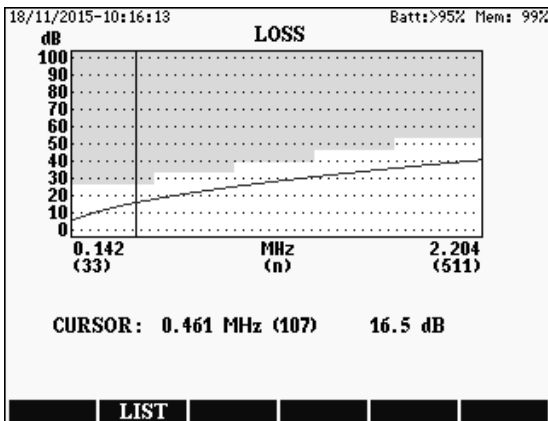


When the qualification is **FAIL** the reasons are marked with asterisks.

To study the detailed result pages

- Draw the highlight on the required result page with the \uparrow/\downarrow keys
- Press **ENTER**

Selecting for example the **CABLE LOSS** result the loss/frequency diagram and the template for pass/fail decision are shown



Moving the cursor line by the horizontal arrow keys, the loss and frequency values belonging to the cursor position are displayed. Pressing the **LIST (F2)** key the test result appears in list form.

7.4 Test Parameters

The test parameters required for the line qualification can be found on five parameter pages. Pressing the **PARAM (F6)** key the system parameter page appears

The system parameters are preprogrammed

18/11/2015-11:13:30		Batt:>95% Mem: 99%	
SYSTEM PARAMETERS			
SYSTEM: G.992.5.B FDD			
	UP	DOWN	
MIN RATES	1184	17696	kbit/s
MAX TX POWER	13.4	20.3	dBm
MAX BITLOAD	15	15	n
CODING GAIN	4.5	4.5	dB
NOISE MARGIN	6.0	6.0	dB
SUB-CHANNEL SPACING		4.3125	kHz
DMM CABLE PSD UP PSD DN			

The further parameters can be reached by the **F4, F5, F6** keys

18/11/2015-13:52:17		Batt:>95% Mem:100%						
CABLE PARAMETERS								
n	kHz	LOSS	IMPEDANCE		LCL	REFL	NEXT	FEXT
		dB	Ohm		dB	dB	dB	dB
		MAX	MIN	MAX	MIN	MIN	MIN	MIN
33	142	26.6						
51	220	26.6	60	200				
127	548	33.7	60	180				
221	953	40.4	60	162				
315	1358	47.0	60	162				
409	1764	54.0	60	162				
511	2204							
IMPED				100	Ohm			
DMM SYSTEM PSD DN PSD UP								

The data transfer speed calculation is based on the S/N ratio.

Testing a passive line the noise can be measured but the signal can't be because there is no operating modem connected. The signal level should be calculated.

For this calculation the Tx PSD masks of the modem must be known.

18/11/2015-10:24:25 Batt:>95% Mem: 99%

UPSTREAM TX PSD TEMPLATE

FREQ		PSD
n	kHz	dBm/Hz
33	142	-38.0
64	276	-38.0

SYSTEM | PSD DN | CABLE

18/11/2015-10:25:02 Batt:>95% Mem: 99%

DOWNSTREAM TX PSD TEMPLATE

FREQ		PSD
n	kHz	dBm/Hz
65	280	-40.0
256	1104	-40.0
376	1622	-50.0
511	2204	-51.4

SYSTEM | PSD UP | CABLE

The DMM parameters are freely settable by the operator

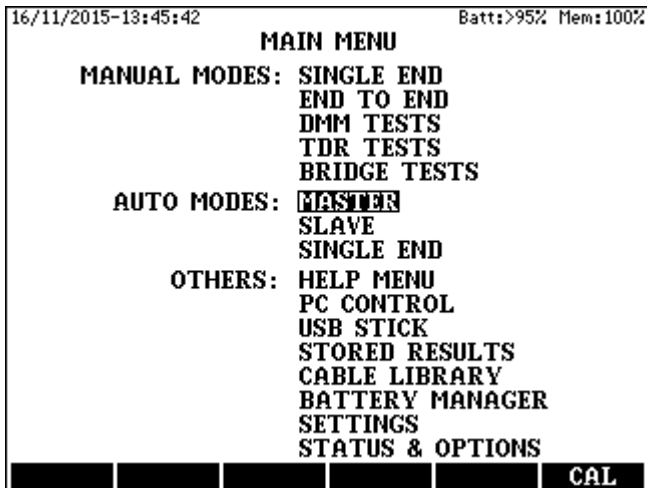
18/11/2015-13:52:53		Batt:>95% Mem:100%	
DMM PARAMETERS			
SYSTEM: G.992.5.B FDD			
DC VOLTAGE	MAX	2.0	V
AC VOLTAGE	MAX	2.0	V
INSULATION	MIN	2	MOhm
		SYSTEM	CABLE

8 AUTOMATIC MASTER SLAVE TEST OF XDSL LINES

8.1 Master Slave Mode Selection

In this test group ELQ 30A provides automatic bi-directional Measurement of principal characteristics of the subscriber line using two instruments. They are connected to the ends of the tested pair in MASTER-SLAVE arrangement. The two instruments communicate over the tested pairs. The Master initializes the measurements and collects the results. The Slave performs the measurements according to the Master's commands and sends back the results.

ELQ 30A can be programmed in the main menu as **MASTER** or **SLAVE**.

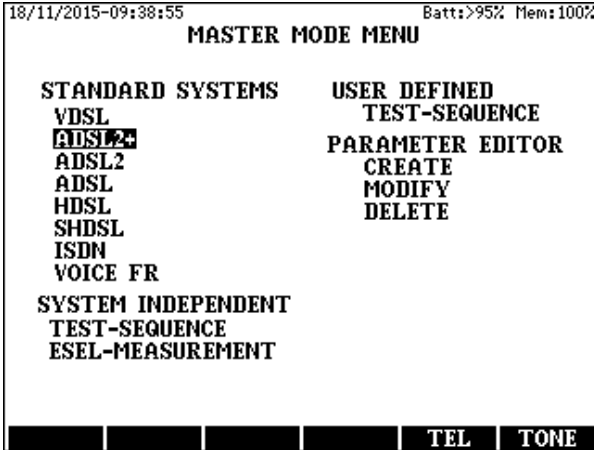


Numerous pre-programmed parameter sets are available for different xDSL systems containing system parameters and cable parameter limits. Pre-programmed system independent test sequences with six frequency ranges are provided for trouble-shooting.

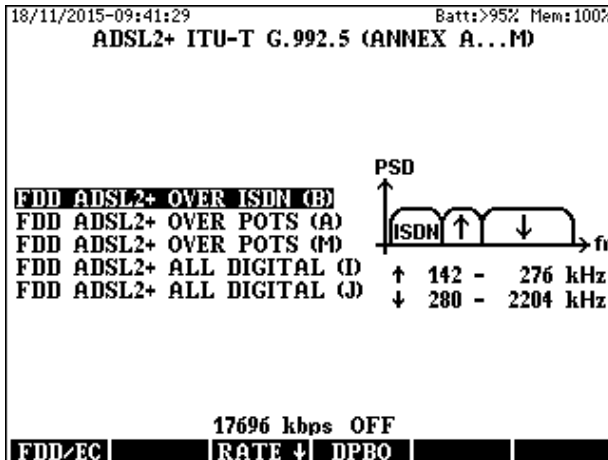
8.2 Preparing the program

When **MASTER** mode is selected the **MASTER MODE MENU** appears providing xDSL system dependent and system- independent automatic test sequence options.

- Enter the required system group (E.g. ADSL2+)



Doing so the ADSL2+ submenu appears



- Draw the highlight on the required system with the \uparrow/\downarrow keys
- Select the required line spectrum with the **FDD/EC (F1)** key
- Press the **RATE ↓ (F3)** key and enter the required bit rate

- In case DPBO is necessary press the **DPBO (F4)** key and enter the required ESEL and MUS values using the corresponding keys
- When the setting of test parameters is completed press **ENTER** and then the automatic program start display appears offering offers three program options
SHORT (loss and noise Measurement)
LONG (Measurement of all characteristics except NEXT and FEXT)
FREE (user selected Measurements)

The program option can be selected with the function keys **F1 to F3**

In case of **FREE** option the user can select the Measurements to be performed. To add or remove a Measurement:

Select the Measurement with the $\uparrow\downarrow$ keys and Press **ENTER**

18/11/2015-10:06:43 Batt:>95% Mem:100%

AUTOMATIC TEST

SYSTEM: G.992.5.B FDD
PROGRAM: STANDARD LONG

TEST

LOSS	L1	#	
NOISE	L1	#	
RET.LOSS	L1	#	
IMPEDANCE	L1	#	
BALANCE	L1	#	
FEXT	L2→L1		
NEXT	L2→L1		

SLAVE:
READY

MEASURING TIME:
02:56

**MASTER AT
REMOTE END**

FREE |
 SHORT |
 LONG |
 TEL |
 MASTER |
 PARAM.

In case of ADSL or VDSL systems the master position should be declared. It can be changed with the **MASTER (F5)** key.

You can reach service telephone mode by pressing **TEL (F4)**

8.3 Running the Program

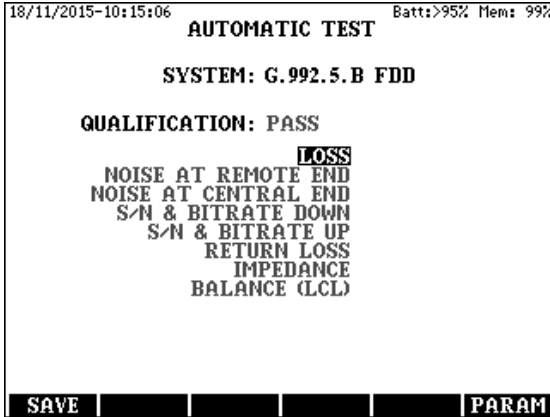
The program can be started or aborted by the **START/STOP** key.

Important note:

Before starting the program be sure that the slave is ready!

Short Form Test Result

When the test program is completed a short form result page appears with immediate **PASS/FAIL** information and with the list of detailed result pages.

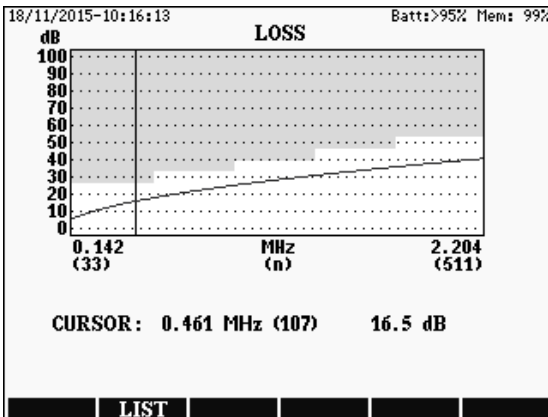


When the qualification is **FAIL** the reasons are marked with asterisks.

To study the detailed result pages

- Draw the highlight on the required result page with the \uparrow/\downarrow keys
- Press **ENTER**
- To return to the short form press **ESC**

Selecting for example the **CABLE LOSS** result the loss/frequency diagram and the template for pass/fail decision are shown

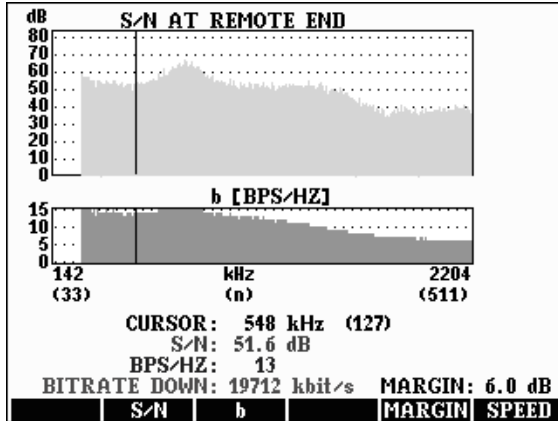


Moving the cursor line by the horizontal arrow keys, the loss and frequency values belonging to the cursor position are displayed.

Pressing the **LIST (F2)** key the test result appears in list form.

8.4 Data Rate Calculation

At system dependent tests the achievable bit rate is calculated with 6 dB default noise margin. The **BITRATE DOWN** and **BITRATE UP** result pages provide additional information about the achievable data rate using 21 different margin values.



To see the list of achievable data rates with different noise margins press the **SPEED (F6)** key and the following display appears

BITRATE DOWN			
MARGIN [dB]	BITRATE [kbps]	MARGIN [dB]	BITRATE [kbps]
0	22368	10	17312 *
1	21984	11	16768 *
2	21600	12	16160 *
3	21184	13	15584 *
4	20672	14	15008 *
5	20192	15	14368 *
6	19712	16	13824 *
7	19104	17	13312 *
8	18528	18	12704 *
9	17952	19	12096 *
		20	11616 *

If the low bit-rate is the reason of failure a new calculation can be performed with a reduced noise margin without starting a new Measurement. To modify the noise margin:

- Press the **MARGIN (F5)** key
- Select a new margin with the $\uparrow\downarrow$ keys and press **ENTER**.

8.5 Checking of Test Parameters

The test parameters of system dependent sequences

The test parameters of the system dependent tests are specified on four parameter pages

Pressing the **PARAM (F6)** key the page of **SYSTEM PARAMETERS** will be shown. The other pages can be called with the **F4, F5, F6** keys.

18/11/2015-10:22:59 Batt:>95% Mem: 99%

SYSTEM PARAMETERS

SYSTEM: G.992.5.B FDD

	UP	DOWN	
MIN RATES	1184	17696	kbit/s
MAX TX POWER	13.4	20.3	dBm
MAX BITLOAD	15	15	n
CODING GAIN	4.5	4.5	dB
NOISE MARGIN	6.0	6.0	dB

SUB-CHANNEL SPACING	4.3125	kHz
----------------------------	---------------	------------

CABLE	PSD UP	PSD DN
--------------	---------------	---------------

18/11/2015-10:23:41 Batt:>95% Mem: 99%

CABLE PARAMETERS

n	kHz	LOSS	IMPEDANCE		LCL	REFL	NEXT	FEXT
		dB	MIN	MAX	MIN	dB	dB	dB
33	142							
51	220	26.6						
127	548	26.6	60	200				
221	953	33.7	60	180				
315	1358	40.4	60	162				
409	1764	47.0	60	162				
511	2204	54.0	60	162				
IMPED		100 Ohm						
		SYSTEM		PSD DN	PSD UP			

The data transfer speed calculation is based on the S/N ratio.

Testing a passive line the noise can be measured but the signal can't be because there is no operating modem connected. The signal level should be calculated.

For this calculation the Tx PSD masks of the modem must be known.

18/11/2015-10:24:25 Batt:>95% Mem: 99%

UPSTREAM TX PSD TEMPLATE

FREQ		PSD
n	kHz	dBm/Hz
33	142	-38.0
64	276	-38.0

[SYSTEM] PSD DN [CABLE]

18/11/2015-10:25:02 Batt:>95% Mem: 99%

DOWNSTREAM TX PSD TEMPLATE

FREQ		PSD
n	kHz	dBm/Hz
65	280	-40.0
256	1104	-40.0
376	1622	-50.0
511	2204	-51.4

[SYSTEM] PSD UP [CABLE]

9 AUTOMATIC MASTER SLAVE TEST OF VF CIRCUITS

ELQ 30A provides the qualification of Leased and Dial-up (Switched) circuits. In MASTER-SLAVE mode ELQ 30A performs automatic bi-directional measurements of principal characteristics of the line using two instruments. They are connected to the ends of the tested pair. The two instruments communicate over the tested line.

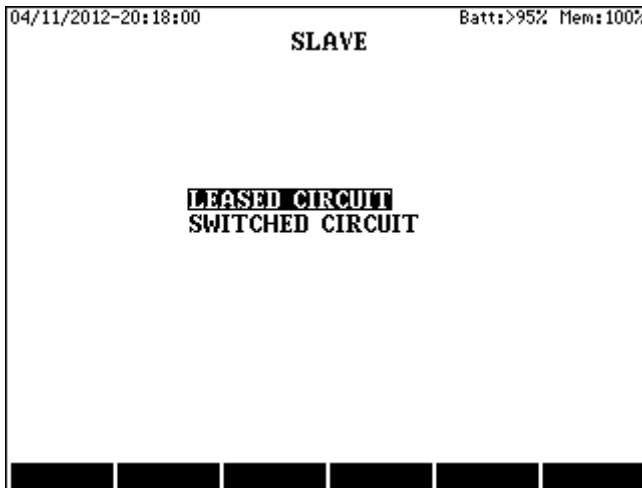
- The Master initializes the measurements and collects the results.
- The Slave performs the measurements according to the Master's commands and sends back the results.

Using pre-programmed system parameters and cable parameter limits ELQ 30A provides immediate **PASS/FAIL** qualification and detailed information about the reasons of failure. ELQ 30A can be programmed as **MASTER** or **SLAVE** as well.

9.1 Slave Mode

For programming ELQ 30A to Slave mode:

- Enter the **SLAVE** option of **MAIN MENU** and the slave display appears



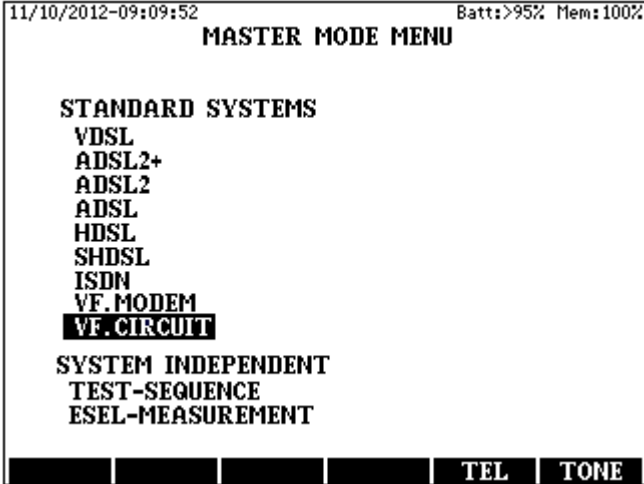
The functions of slave depend on the type of tested line. There are two possibilities: Leased or Switched circuit. (The default is LEASED).

When the Master and Slave should communicate over an exchange enter the **SWICHED CIRCUIT** option

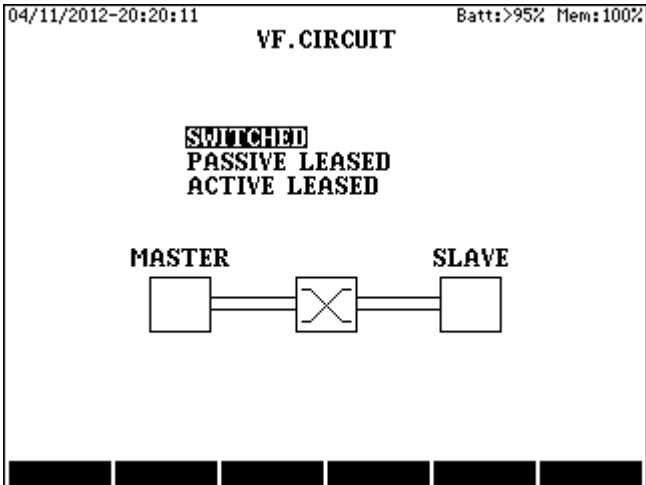
9.2 Master Mode

Preparing the program



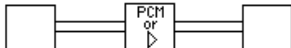
- Select the **MASTER** option of **MAIN MENU**



- Enter the **VF. CIRCUIT** option



- Enter the required type then one of the next three displays appears

04/11/2012-20:20:45		Batt:>95% Mem:100%	
SWITCHED CIRCUIT MASTER MODE			
ITU-T M.1020 ITU-T M.1025 ITU-T M.1040			
MASTER			SLAVE
PHONE NUMBER OF SLAVE:			
TO CHANGE PHONE NUMBER PRESS EDIT			
EDIT			
04/11/2012-20:21:15		Batt:>95% Mem:100%	
PASSIVE LEASED CIRCUIT MASTER MODE			
ITU-T M.1020 ITU-T M.1025 ITU-T M.1040			
MASTER			SLAVE
04/11/2012-20:21:38		Batt:>95% Mem:100%	
ACTIVE LEASED CIRCUIT MASTER MODE			
ITU-T M.1020 ITU-T M.1025 ITU-T M.1040			
MASTER			SLAVE

- Enter the required quality then showing the list of the selectable measurements one of the next three displays appears

04/11/2012-20:23:12		Battt:>95% Mem:100%	
AUTOMATIC TEST			
CIRCUIT	SWITCHED		
LOSS	[*]		
NOISE	[*]		
TOTAL DISTORTION	[*]		
RETURN LOSS	[*]		
IMPEDANCE	[*]		
BALANCE (LCL)	[*]		
GROUP DELAY	[*]		
JITTER & FREQ	[*]		
EVENT COUNTER	[*]		
RECEIVER DELAY	0	s	
SLAVE PHONE NUM	3402136		
SELECT/DESELECT TEST BY ↑↓ & ENTER START TEST BY ST/SP			
MEASURING TIME:			
			PARAM

04/11/2012-20:27:16		Battt:>95% Mem:100%	
AUTOMATIC TEST			
CIRCUIT	PASSIVE LEASED		
LOSS	[*]		
NOISE	[*]		
RETURN LOSS	[*]		
IMPEDANCE	[*]		
BALANCE (LCL)	[*]		
GROUP DELAY	[*]		
JITTER & FREQ	[*]		
NEXT	[*]		
FEXT	[*]		
EVENT COUNTER	[*]		
SELECT/DESELECT TEST BY ↑↓ & ENTER START TEST BY ST/SP			
MEASURING TIME:			
			PARAM

04/11/2012-20:32:51		Battt:>95% Mem:100%	
AUTOMATIC TEST			
CIRCUIT	ACTIVE LEASED		
LOSS	[*]		
NOISE	[*]		
TOTAL DISTORTION	[*]		
RETURN LOSS	[*]		
IMPEDANCE	[*]		
BALANCE (LCL)	[*]		
GROUP DELAY	[*]		
JITTER & FREQ	[*]		
NEXT	[*]		
FEXT	[*]		
EVENT COUNTER	[*]		
RECEIVER DELAY	0		
SELECT/DESELECT TEST BY ↑↓ & ENTER START TEST BY ST/SP			
MEASURING TIME:			
			PARAM

- Select the measurements to be performed
- To see the test parameters press the **PARAM (F6)** key

9.3 Running the Program

The program can be started or aborted by the **START/STOP** key.

If the test-object is a leased circuit

The master and the slave start to communicate automatically when the test sequence is started with the **START/STOP** key.

If the test-object is a switched circuit

Pressing the **START/STOP** key the master first dials up the slave. The user is continuously kept informed about the state of calling. When the slave is connected and the two ELQ 30A instruments effected the communication the test sequence is started automatically.

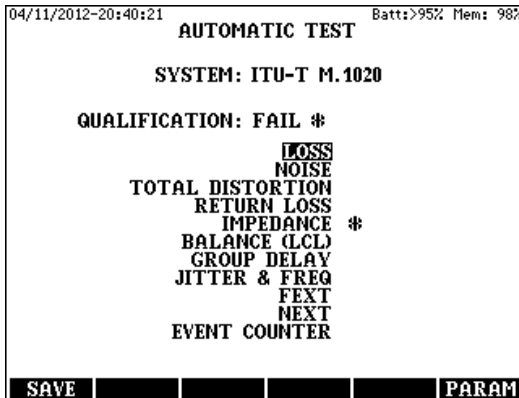
Having the automatic test program started with the **START/STOP** key the measuring picture appears informing the user about the progress of the test sequence.

04/11/2012-20:45:56	AUTOMATIC TEST	Batt:>95% Mem: 98%
SYSTEM: ITU-T M.1020		
QUALIFICATION: FAIL #		
	LOSS	+
	NOISE	+
TOTAL DISTORTION		+
RETURN LOSS		+
IMPEDANCE		☑
BALANCE (LCL)		
GROUP DELAY		
JITTER & FREQ		
	FEXT	
	NEXT	
EVENT COUNTER		
SAVE		PARAM

9.4 Test Results

Short Form Test Result

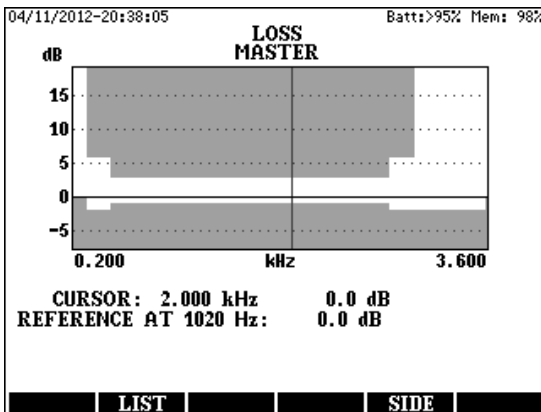
When the test program is completed a short form result page appears with immediate **PASS/FAIL** information and with the list of detailed result pages. When the qualification is **FAIL** the reasons are marked with asterisks.



To study the detailed result pages

- Draw the highlight on the required result page with the \uparrow/\downarrow keys
- Press **ENTER**

Selecting for example the **CABLE LOSS** result the loss/frequency diagram and the template for pass/fail decision are shown.



- Press the **LIST (F2)** key to see the test result In list form

Special features

ELQ 30A provides master slave measurement for the test of very long lines having very high propagation delay (Up to 10 sec).

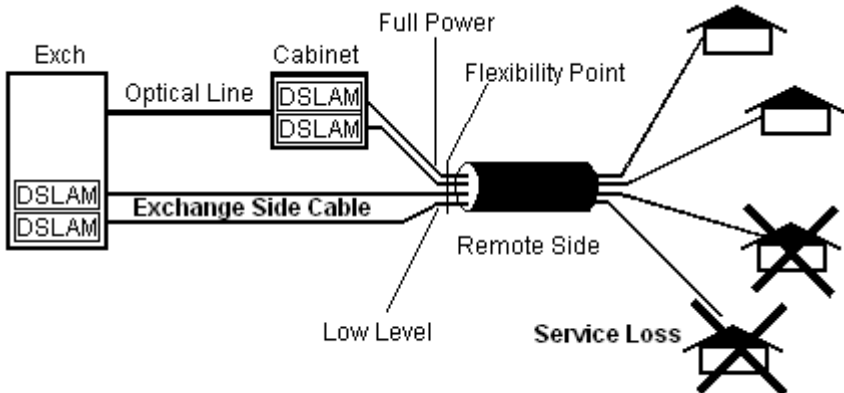
In case of the test of circuits having high propagation delay the required receiver delay of ELQ 30A can be set in the following way:

- Enter the **RECEIVER DELAY** option of **AUTO TEST** menu
- Set the required receiver delay with the number keys
- Press **ENTER**

10 ESEL MEASUREMENT

The development of Triple Play services requires higher bandwidth. Higher bandwidth and substantial performance gain can be reached by deploying DSLAM-s in a remote side cabinet near to the customer premises. There is no problem at clean networks where all the customers are connected to the same local cabinet.

At mixed networks a part of subscriber lines are directly connected to the Exchange and others to the local DSLAM-s. Serious crosstalk problem and service loss may occur if the local DSLAM-s work with full power because in that case there is a considerable level difference between the directly connected and local lines at the flexibility point where the lines are adjoining.



The generally accepted method to protect the directly connected customers is the use of **Spectrum Shaping** or other words Downstream Power Back Off (**DPBO**) at the local DSLAM-s in cabinet.

The key points in local DSLAM programming is the electrical length of Exchange Side Cable (**ESEL**). The value of **ESEL** is equal with the measured attenuation of Exchange Side Cable at 1 MHz between the Exchange and local DSLAM.

ELQ 30A provides ESEL measurement until 120 dB in MASTER- SLAVE arrangement.

10.1 ESEL Measuring Method of ELQ 30A

In case of long cables the loss measurement at 1 MHz can be inaccurate if the noise level is high. To eliminate this problem ELQ 30A applies the combination of loss and noise measurement.

The exchange side instrument supply high level test signals gradually increasing the frequency until 1 MHz.

The remote side instrument performs signal and noise measurements on the gradually increasing frequencies until the S/N ratio sinks below a designated threshold. Over this critical frequency ELQ 30A applies extrapolation using the characteristic of a reference cable.

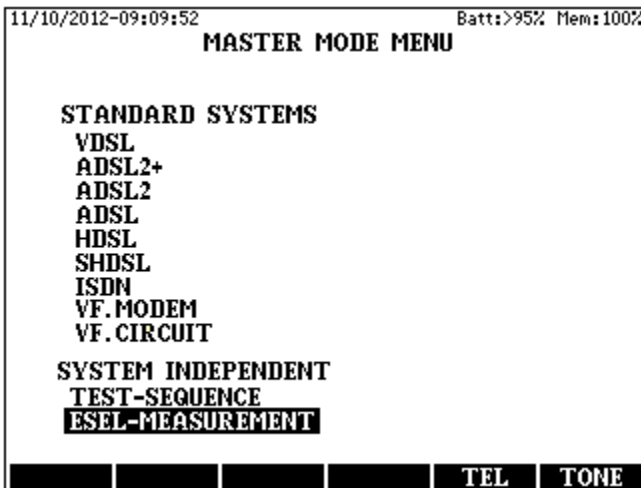
10.2 Preparing the ESEL Measurement

At the SLAVE side

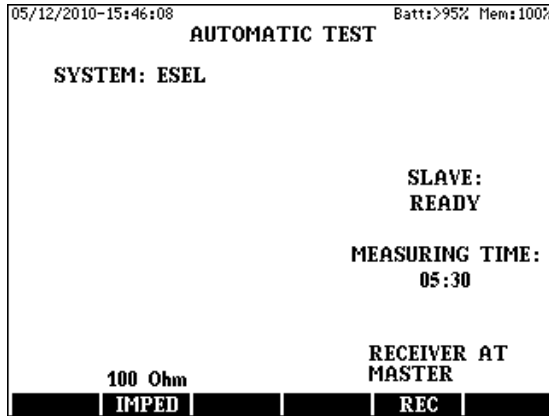
- Enter the **SLAVE** option of **MAIN MENU**

At the MASTER side

- Enter the **MASTER** option of **MAIN MENU**
- Enter the **ESEL-MEASUREMENT** option of **MASTER MODE MENU**



Doing so the **ESEL-MEASUREMENT** display appears



- Press the **IMPED. (F2)** key and select the required line impedance
- Select the location of receiving with the **REC. (F5)** key

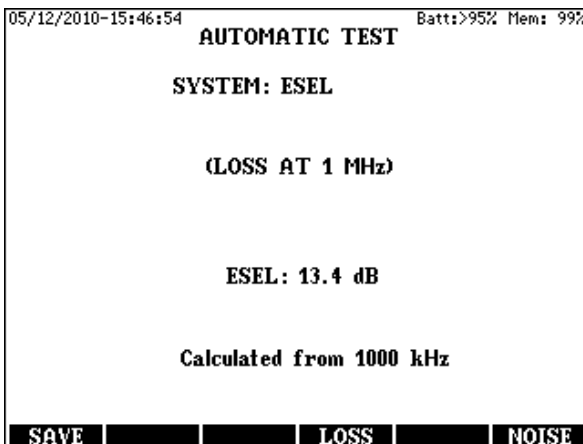
Important Note:

At this measurement the RECEIVER must be at the REMOTE end!

10.3 Measuring Process

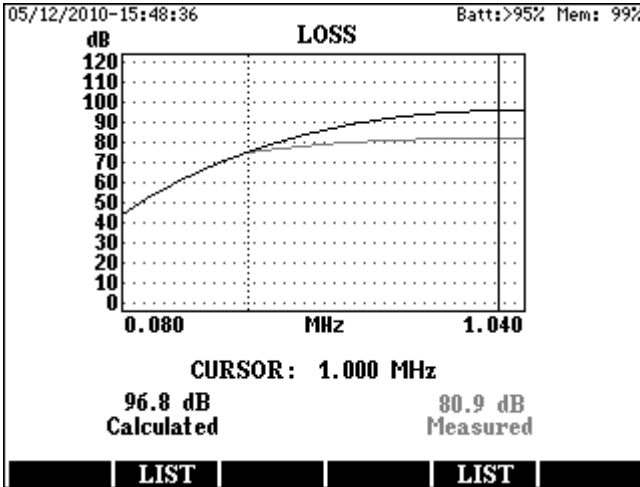
Start the measurement with the **STAR/STOP** key

When the test sequence is ready the appearing **ESEL RESULT** display shows the calculated **ESEL** value and the number of the last sub carrier over which extrapolation is applied.



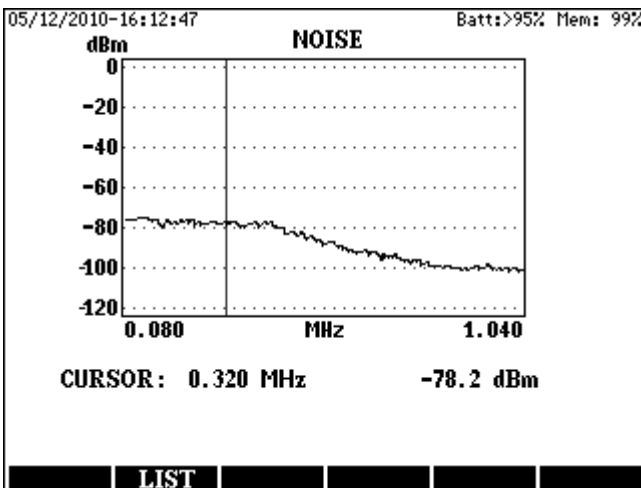
10.4 Test Results

Pressing **LOSS (F4)** key the **LOSS** display appears showing the calculated and the measured loss characteristics. The measuring results are available in numeric form as well. To see the numeric values press the **LIST (F2)** or **LIST (F5)** key



To see the noise level:

- Return with **ESC** to the **ESEL RESULT** display and
- Press the **NOISE (F6)** key



11 BATTERY MANAGER

Battery Charging Modes

ELQ 30A is equipped with a processor controlled automatic charger-discharger circuit providing the following functions:

- Battery capacity indication
- Charging process control:
 - Normal charging
 - Fast charging
 - Battery regeneration
 - Battery initialization
 - Protection against deep discharging

These functions can be reached in **MAIN MENU / BATTERY MANAGER**

11.1 Battery Capacity Indication

The battery manager system continuously measures the battery state.

When ELQ 30A is switched on battery information appears showing the actual state of battery in % form.

11.2 Normal Charging

When the mains adapter is connected and the battery level sinks below 60% the automatic circuit starts normal charging with 0.1C (C is the nominal capacity of the built in battery)

When the full charge is reached the control system automatically stops charging and the **BATTERY LEVEL > 95 %** indication appears.

The **CHARGE** indicator LED is lighted while the charging is in progress. When full charge is reached, the charger is automatically switched off, and the **CHARGE** indicator LED goes out.

11.3 Fast Charging

When **FAST CHARGING** or regenerative charging is selected in the **BATTERY MANAGER MENU** the battery is charged with a relatively high current (0.5C) for approx. 2 to 3 hours during which the instrument can't be used. In this mode after a short time the instrument is automatically switched off. If temperature of the battery exceeds the environment by 10°C the charging is automatically finished.

The blinking of **CHARGE** indicator LED indicates that the process is in progress.

When the charging is completed the charge indicator goes out, and the instrument stays switched off.

Switching the instrument on during the process:
Information can be obtained about the current battery
The process can be aborted by pressing the **ABORT (F3)** key.

11.4 Regenerating Charge Process

In this mode the battery is discharged and fast charged. The instrument can't be used during this process. To start regenerating process:

Enter **BATTERY MANAGER**

Select the **REGENERATING** option and press **ENTER**

In the first phase, discharging message is displayed. In the second phase, the instrument is automatically switched off, and the charge indicator LED is blinking.

The process can be interrupted by pressing the **ABORT (F3)** key.

11.5 Initial Charging

The initialization is the first charging of battery. It is necessary when the **INITIAL CHARGING RECOMMENDED** warning appears (The same process is required when the battery is replaced.) The process can be started by the **START/STOP** key

During the 2 to 3 hour process the battery state measuring system will be calibrated. The initial process can be skipped or interrupted but in these cases always the **BATTERY LEVEL IS UNKNOWN** battery charging level indication appears when the instrument is switched on. Therefore the skipping or interruption of the process is not recommended.

DO NOT CHARGE THE BATTERIES WHEN THE AMBIENT TEMPERATURE IS BELOW +5 °C OR OVER +45 °C.

12 USB PORTS

ELQ 30A has two USB ports:

- USB A host port for USB stick
- USB B device port for PC connection

There are two transfer options:

- Result transfer
- Parameter set transfer

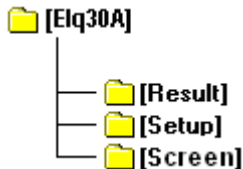
Important note: The options can be used only if they are activated in ELQ 30A.

12.1 USB A port for USB stick

ELQ 30A can be connected to a USB stick via USB A interface. The USB stick provides data transfer between a PC and ELQ 30A without installing a special device driver to the PC.

This solution is advantageous for the user who does not have a PC on the spot of the measurement

ELQ 30A uses the following directory structure:



At data transfer from PC via USB stick you have to use that structure.

12.2 USB B port for PC connection

ELQ 30A can be connected to a PC via USB B interface.

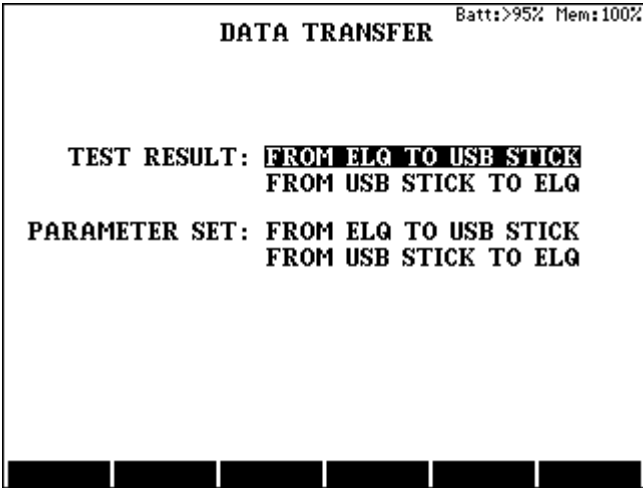
The ELQ30c.exe control program provides the following features:

- Transfer and post processing of test results
- Parameter set transfer and edition
- Checking the HW and SW version and other features of ELQ 30A

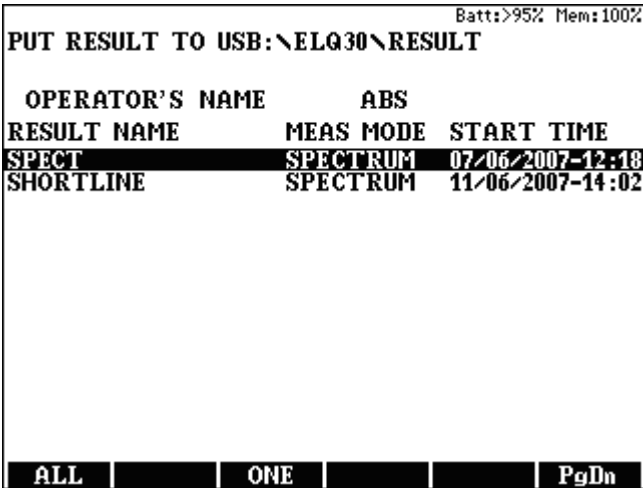
12.3 Result Transfer from ELQ 30A to USB Stick

- Plug the USB stick into the **USB host Port** of ELQ 30A
- Enter the **USB STICK** option of **MAIN MENU**

Doing so the **DATA TRANSFER** page appears



Select and enter the **FROM ELQ TO USB STICK** option



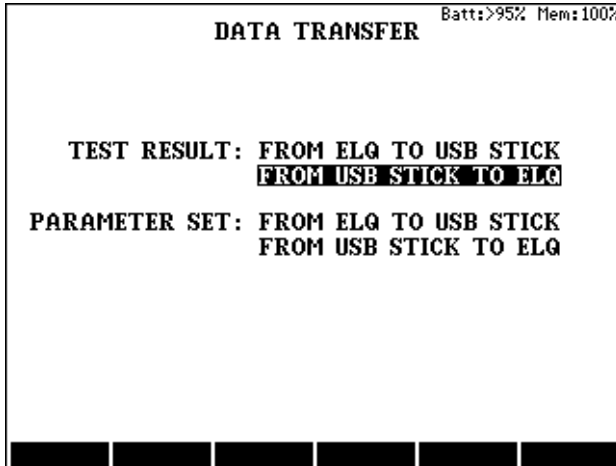
To copy only one of the test results to USB stick draw the highlight to the wanted name and press the **ONE (F3)** key
 To copy all test results press the **ALL (F1)** key

12.4 Result Transfer from USB Stick to ELQ 30A

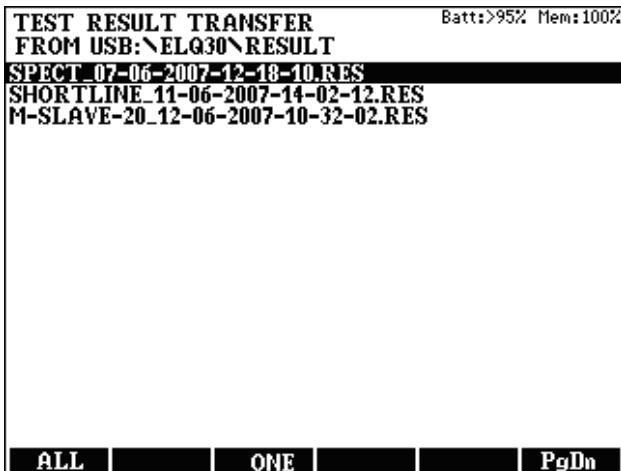
Plug the USB stick into the **USB host Port** of ELQ 30A

Enter the **USB STICK** option of **MAIN MENU**

Doing so the **DATA TRANSFER** page appears



Select and enter the **FROM USB STICK TO ELQ** option



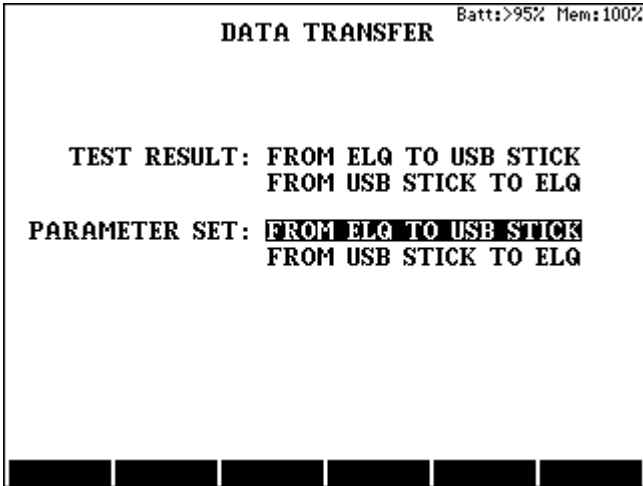
- To copy only one of the test results to USB stick draw the highlight to the wanted name and press the **ONE (F3)** key
- To copy all test results press the **ALL (F1)** key

12.5 Parameter Set Transfer from ELQ 30A to USB Stick

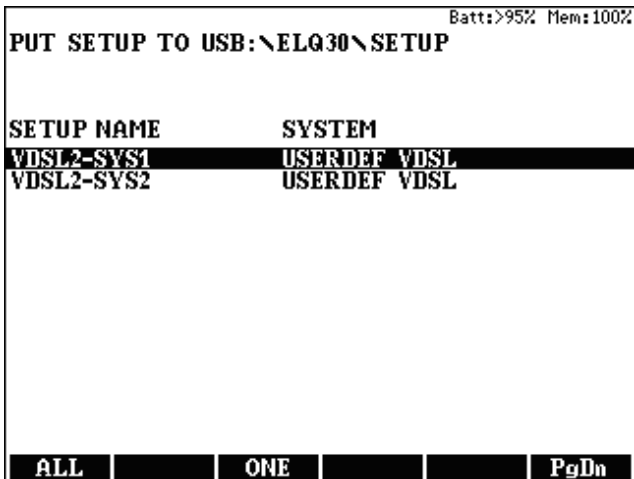
Plug the USB stick into the **USB host Port** of ELQ 30A

Enter the **USB STICK** option of **MAIN MENU**

Doing so the **DATA TRANSFER** page appears



Select and enter the **FROM ELQ TO USB STICK** option



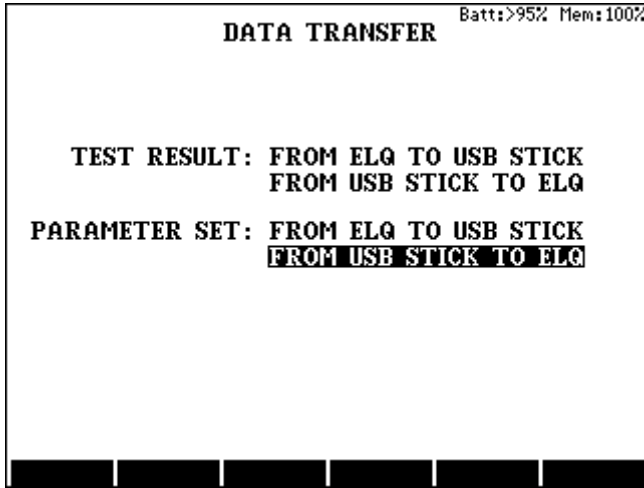
- To copy only one of the parameter sets to USB stick draw the highlight to the wanted name and press the **ONE (F3)** key
- To copy all the parameter sets to USB stick press the **ALL (F1)** key

12.6 Parameter Set transfer from USB Stick to ELQ 30A

Plug the USB stick into the **USB host Port** of ELQ 30A

Enter the **USB STICK** option of **MAIN MENU**

Doing so the **DATA TRANSFER** page appears



- Select and enter the **FROM USB STICK TO ELQ** option



To copy only one of the parameter sets to USB stick draw the highlight to the wanted name and press the **ONE (F3)** key

To copy all the parameter sets to USB stick press the **ALL (F1)** key

12.7 Image Transfer to USB Stick

Pressing the **PRINT SCREEN** key the actual content of the display will be transferred to the **[Screen]** folder of USB stick in bmp format.

13 STATUS & OPTIONS

Status & Options point of the **MAIN MENU** provides useful hardware and software information:

05/12/2010-16:19:01	ABOUT	Batt:>95% Mem:100%
DEVICE TYPE	ELQ30A	
SERIAL NUMBER	1234567890	
INTERNAL ID	01	
CPU CARD NUMBER	12345	
AV CARD NUMBER	67890	
BR CARD NUMBER	ABCDEF	
CALIBRATION DATE	05/12/2010-13:49:45	
CHARGER VERSION	0102030405	
BOOT VERSION	1	
SOFTWARE VERSION	0.01	
HARDWARE VERSION	12345/67890/ABCDEF	
		PgDn

In case of Master-Slave Measurements the two instruments must have the same software version number!

14 SOFTWARE UPGRADE (ELQ30U.EXE)

The software of ELQ 30A can be upgraded without disassembling the instrument. The new software version can be downloaded from a PC using the upgrade file made by the manufacturer. This file contains the description of the upgrade process.

To set ELQ 30A to upgrade mode:

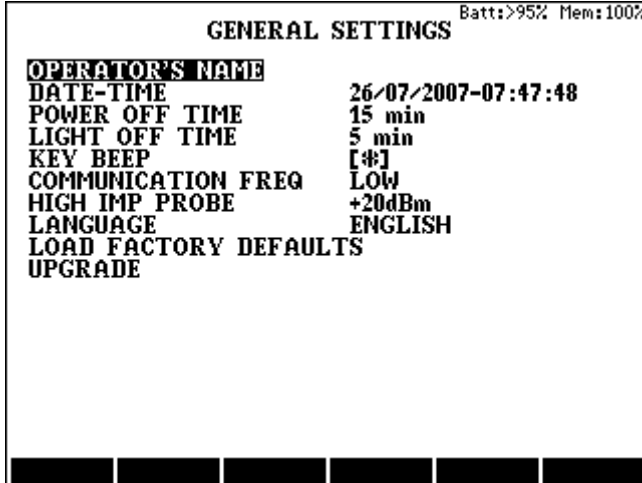
- Enter **SETTINGS**
- Select the **UPGRADE** option with the vertical cursor keys
- Press **ENTER**

Doing so ELQ 30A is ready for upgrade. To return without upgrade switch the instrument off.

15 SETTINGS

In setting mode some important parameters can be set.

The menu of general settings can be reached from the main menu



The date and time can be typed in with the number keys. The name of operator can be typed in like an SMS at mobile phones. (space by key **0** twice, backspace by **←**, accept by **ENTER**, escape by **ESC**)

To change the other parameters:

- Select the parameter by the vertical cursors and press **ENTER**.
- Change parameter by the vertical cursors and press **ENTER**.

Note: In **SLAVE** mode the power off system is not active.

16 SPECIFICATIONS

16.1 General Specifications

Power supply:

Internal rechargeable NIMH battery pack

Operation time..... approx. 8 hours
(Without backlight)

Charging (without taking the battery pack out)

From 100 to 264 VAC with mains adapter

From 12 V car battery with car adapter

Charging time..... less than 3 hours
(Fast charging mode)

Display 320 x 240 color LCD-TFT

Connectors

Connector for mains or 12V car adapter 2.1/5.5 mm coaxial

Power supply connector for active probe Mini-din-4P

Line connectors..... 4 mm banana sockets

Ground connector 4 mm banana socket

USB A USB 1.1 host port for USB-Stick
(FAT16, FAT32 file system supported)

USB BUSB 1.1 device port to connect PC

Over voltage protection

Between a and b or ground..... 200 V DC

Longitudinal voltage 60 V AC

Ambient temperature ranges

Reference.....23±5°C
Rel. humidity 45% to 75%

Normal operation..... 0 to +40°C
Rel. humidity 30% to 75% *(<25g/m³)

Limits of operation..... -5 to +45°C
Rel. humidity 5% to 95% *(<29g/m³)

Storage and transport -40 to +70°C
Rel. humidity 95% at +45°C *(<35g/m³)

Dimensions 224 x 160 x 44 mm

Weight (Including battery pack)approx. 1.5 kg

* Without condensation

16.2 Single End Manual Tests

Receiver

Inputs

10 kHz to 30 MHz	100, 135, 150 Ω Balanced or High
200 Hz to 10 kHz	600 Ω Balanced or High

Selective Level Measurement

Frequency

Frequency Range	200 Hz to 30 MHz
Frequency resolution	1 Hz
Frequency accuracy.....	$2 \times 10^{-6} \pm 1$ Hz

Receiving modes One Frequency/MTTS/Sweep

Band width

200 Hz to 10 kHz	20 Hz
10 kHz to 5 MHz	20, 200 Hz, 1.74, 1.95, 3.1 kHz
5 MHz to 18 MHz	200 Hz, 1.74, 1.95, 3.1 kHz
18 MHz to 30 MHz	1.74, 1.95, 3.1 kHz

Measuring Range (with 20 Hz band width)

10 kHz to 30 MHz	-120 to +10 dBm
200 Hz to 10 kHz	-120 to +4 dBm
Level Resolution	0.1 dB

Accuracy at 0 dBm

200 Hz to 10 kHz	$\pm 0,5$ dB
10 kHz to 5 MHz	$\pm 0,3$ dB
5 MHz to 30 MHz	± 1 dB

Wideband Level Measurement

Frequency Range 200 Hz to 30 MHz

Measuring Range

10 kHz to 30 MHz	-50 to +10 dBm
200 Hz to 10 kHz	-50 to +4 dBm
Level Resolution	0.1 dB

Accuracy at 0 dBm

200 Hz to 10 kHz	$\pm 0,5$ dB
10 kHz to 5 MHz	$\pm 0,3$ dB
5 MHz to 30 MHz	± 1 dB

Transmitter

Outputs

10 kHz to 30 MHz 100, 135, 150 Ω Balanced
 200 Hz to 10 kHz 600 Ω Balanced

Frequency

Frequency Range 200 Hz to 30 MHz
 Frequency resolution 1 Hz
 Frequency accuracy $2 \times 10^{-6} \pm 1$ Hz

Transmitting modes One Frequency/MTTS/Sweep

Output level

10 kHz to 30 MHz +10 to -40 dBm
 200 Hz to 10 kHz +4 to -45 dBm
 Level Resolution 0.1 dB

Accuracy at 0 dBm

200 Hz to 10 kHz $\pm 0,5$ dB
 10 kHz to 5 MHz ± 0.3 dB
 5 MHz to 30 MHz ± 1 dB

NEXT/ Loss Measurement

Frequency

Frequency Range 200 Hz to 30 MHz
 Frequency resolution 1 Hz
 Frequency accuracy $2 \times 10^{-6} \pm 1$ Hz

Impedances

10 kHz to 30 MHz 100, 135, 150 Ω
 200 Hz to 10 kHz 600 Ω

Measuring modes One frequency, Sweep

Measuring range

NEXT up to 80 dB
 Loss up to 90 dB

Single-End Insertion Loss Measurement

Frequency Ranges	1.5, 3,9,12,18,30 MHz
Line length range	100 m to 6 km
Direct measurement	100 kHz to 6 MHz or Up to 45 dB cable loss
Extrapolation	Over 6 MHz or Over 45 dB cable loss
Vertical scale	0 to 80 dB
Accuracy	2 to 4 dB

LCL Balance Measurement

Frequency range	200 Hz to 30 MHz
Impedances	100, 135, 150 Ω
Display range:	0 to 70 dB
Accuracy at 35 dB with special balanced cable	
200 Hz to 100 kHz	± 2 dB
100 kHz to 5 MHz	± 1 dB
5 MHz to 30 MHz	$\pm 2,5$ dB

Return Loss Measurement

Frequency range	200 Hz to 30 MHz
Line impedances (Z)	
10 kHz to 30 MHz	100, 135, 150 Ω
200 Hz to 10 kHz	600 Ω
Display range:	up to 40 dB
Accuracy at 20 dB	
200 Hz to 18 MHz	± 2 dB

Impedance Measurement

Frequency range	200 Hz to 30 MHz
Measuring range	
10 kHz to 30 MHz	50 to 400 Ω
200 Hz to 10 kHz	300 to 1600 Ω
Accuracy	
200 Hz to 10 kHz	$\pm 10\% \pm 5 \Omega$
10 kHz to 18 MHz	$\pm 5\% \pm 5 \Omega$
18 MHz to 30 MHz	$\pm 10\% \pm 5 \Omega$

Spectrum Analyzer

Frequency range200 Hz to 30 MHz
 Line impedances
 10 kHz to 30 MHz..... 100, 135, 150 Ω or High
 200 Hz to 10 kHz..... 600 Ω or High
 Display rangedown to -140 dBm/Hz
 Maximum input level
 With high impedance probe +20 dBm
 Without high impedance probe
 200 Hz to 10 kHz..... +4 dBm
 10 kHz to 30 MHz..... +10 dBm

Frequency Range	Bandwidth & Freq. Step
30 MHz	500 Hz to 100 kHz
18 MHz	500 Hz to 60 kHz
12 MHz	500 Hz to 40 kHz
9 MHz	500 Hz to 30 kHz
3 MHz	500 Hz to 10 kHz
1.5 MHz	500 Hz to 5 kHz
600 kHz	500 Hz to 2 kHz
300 kHz	500 Hz to 1 kHz
20 kHz	50 Hz to 100 Hz
4 kHz	10 Hz to 20 Hz
0.3 kHz	1 Hz

Number of displayed frequencies..... 300
 Saving of result.....the actual content of display
 Evaluation..... NORM, PEAK, AVG, SAVG
 Units dBm, dBm/Hz

Wideband noise Measurement

Frequency range 200 Hz to 30 MHz
 Filters for noise Measurements: ... ADSL, ADSL 2+, VDSL, P, No Filter
 Measurement times: 1sec to 72 hours
 Evaluation for 1 sec to 1 minQuasi analogue
 Evaluation for 5 min to 72 hour..... Histogram with 60 time slots

Impulse Noise Measurement

Pulse width > 500 ns
 Interval size > 10 ms
 Threshold range1 to 500 mV
 Maximum count: 65000
 Measuring times 1sec to 72 hours
 Evaluation for 1 to 30 sec numeric
 Evaluation for 1 min to 72 hour Histogram with 60 time slots

16.3 End to End Manual Tests

Noise with Tone Measurement

Transmitter

Impedance.....	600 Ohm
Test signal.....	1020 Hz
Output level.....	0 dBm

Receiver

Impedance.....	600 Ohm
Measuring range	0 to -80 dBm
Weighting filters.....	Psophometric (O.41) 1020 Hz Notch (O.132)

Measurement times	1s to 30 min
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Group Delay Distortion Measurement

Transmitter

Impedance	600 Ohm
Test signal	36MTTS, 200 to 3700 Hz
Resolution.....	100 Hz
Output level.....	-20 dBm/tone (3dBm peak)

Receiver

Impedance	600 Ohm
Input level range	-50 to -10 dB/tone
Group delay distortion range	0 to 5 ms
Resolution.....	1 μ s
Reference	Smallest, 800 Hz, 1000 Hz, 1800 Hz

Phase Jitter & Frequency Error Measurement

Transmitter

Impedance.....	600 Ohm
Test signal	1020 Hz
Output level	0 dBm

Receiver

Input level range	0 to -30 dBm
<u>Phase Jitter measurement (O.91)</u>	
Measuring range.....	0.2 to 30.0 degrees p-p
Filter.....	4 to 300 Hz
<u>Frequency Error Measurement</u>	
Measuring range.....	\pm 30 Hz
Resolution.....	0.1 Hz

Simultaneous Event Counter

Transmitter

Impedance	600 Ohm
Test signal.....	1020 Hz
Output level.....	0 dBm

Receiver

Impedance	600 Ohm
Input level range	0 to -30 dBm
Measurement times	5, 15, 30, 60 min
Maximum count for each counter	65000

Amplitude Hit Counter (O.95)

Threshold range.....	2 to 9 dB
Guard interval	4 ms
Dead time.....	125± 25 ms
Dead time after interruption (>10 dB drop)	1 s

Phase Hit Counter (O.95)

Threshold range.....	5 to 45 °
Guard interval	4 ms
Dead time.....	125± 25 ms

Interruption counter (O.61)

Threshold	6, 10 dB
Guard interval	2 ms
Dead time.....	3± 1 ms

Impulsive Noise counter (O.71)

Filter	1020 Hz Notch
Guard interval	20 µs
Dead time.....	125 ± 25 ms
Threshold range.....	0 to -50 dBm

16.4 Automatic Single Ended Test Sequences

DMM Tests

AC, DC Voltage.....	a-b, a-E, b-E
Insulation Resistance.....	a-b, a-E, b-E
Capacitance	Cm, Ca-E, Cb-E

Selectable Line Tests

Loss	Estimation
Noise	Measurement at near end Estimation at far end
LCL Balance.....	Measurement
Return Loss	Estimation
Impedance.....	Estimation
NEXT.....	Estimation

Calculations (Predictions)

S/N.....	near & far end
Data Transfer Speed	Up& Down Stream
Bit allocation (b).....	For VDSL & ADSL

Predefined Parameter Sets

VDSL 2.....	OVER ISDN, OVER ISDN WITHOUT US0 OVER POTS, OVER POTS WITH EXTENDED US0
ADSL 2+.....	Annex A, B, I, J, M
ADSL 2.....	Annex A, B, I, J, M
ADSL.....	Annex A, B
ADSL G.Lite2	Annex A, I
READSL2.....	Annex L
SHDSL	Annex B, E
HDSL.....	2B1Q, CAP
ISDN.....	Basic rate, Primary rate

User Defined Test Parameters

AC, DC Voltage.....	Maximum
Insulation Resistance.....	Minimum

16.5 Automatic Master Slave Test of xDSL Lines

Selectable Line Tests

Loss	Measurement
Noise.....	Bilateral Measurement
LCL Balance	Bilateral Measurement
Return Loss	Bilateral Measurement
Impedance	Bilateral Measurement
NEXT	Bilateral Measurement
FEXT	Bilateral Measurement

Calculations

S/N	Bilateral Measurement
Data Transfer Speed	Up& Down Stream Calculated
Bit allocation (b)	Up& Down Stream Calculated for VDSL & ADSL

Predefined Parameter Sets

VDSL 2.....	OVER ISDN, OVER ISDN WITHOUT US0 OVER POTS, OVER POTS WITH EXTENDED US0
ADSL 2+	Annex A, B, I, J, M
ADSL 2.....	Annex A, B, I, J, M
ADSL.....	Annex A, B
ADSL G.Lite2.....	Annex A, I
READSL2	Annex L
SHDSL.....	Annex B, E
HDSL	2B1Q, CAP
ISDN.....	Basic rate, Primary rate

ESEL Measurement

Measuring range	Up to 120 dB
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ESEL Dependent Templates

Applicable.....	For all ADSL 2+ Systems
Selectable ESEL values	0 to 120 dB
ESEL steps	1 dB

16.6 Automatic Master Slave Test of VF circuits

Test Objects

Passive Leased Circuit.....	Cable
Active Leased Circuit.....	Containing amplifiers or digital equipment
Switched Circuit.....	Master & Slave communicates over exchange

Selectable Line Tests

Loss	Bilateral Measurement
Noise	Bilateral Measurement
Total distortion	Bilateral Measurement
LCL Balance	Bilateral Measurement
Return Loss	Bilateral Measurement
Impedance.....	Bilateral Measurement
Group Delay Distortion	Bilateral Measurement
Phase Jitter & Frequency Error	Bilateral Measurement
Simultaneous Event Test	Bilateral Measurement

Predefined Parameter Sets

M 1020.....	Active, Passive, Switched
M 1025.....	Active, Passive, Switched
M 1040.....	Active, Passive, Switched

16.7 TDR Measurements

Measuring Modes

Single Pair

Short time	L1
Short time automatic.....	L1 AUTO
Long time	L1 LT

Comparison to memory

Living line & memory	L1 & M
Living line - memory	L1-M

XALK.....XTALK

XALK automaticXTALK AUTO

Impedance 100 Ohm

Measuring ranges 16, 32, 64, 160, 320, 640 m
1.6, 3.2, 6.4, 16, 32 km

Zoom..... 1 to 5

Gain range0 to 90 dB

Measuring pulse

Width.....	6, 10, 30, 60, 100, 300, 600 ns 1, 3, 6 μ s
Amplitude	~3 V

Propagation velocity

V	90 to 299m/ μ s
V/2.....	45 to 150 m/ μ s
PVF	0.3 to 0.999

Accuracy $\pm 0.5\%$ ± 1 m

16.8 High Impedance Probe

Frequency range..... 5 kHz to 30 MHz

Attenuation..... 15 dB

Input Impedance 5 kOhm || 5pF

Accuracy

5 kHz to 25 kHz	± 1 dB
25 kHz to 5 MHz	± 0.3 dB
5 MHz to 30 MHz	± 1 dB

17 ORDERING INFORMATION

COPPER QUALIFIER ELQ 30A433-000-000

Including:

Operating Manual	OM433-015-011 xE
Calibration Certificate	CC433-000-000 E
CD (xxx version).....	CD433-905-xxx E
Measuring cable yellow.....	Y107-444
Measuring cable green.....	Y107-445
2 pcs Special Balanced Measuring Cable (L1, L2).....	Y107-446
USB cable	Y107-389
USB stick	Y146-019
Mains adapter	Y107-017
Battery (built-in)	355-140-000B
Carrying case	Y147-014
6 Alligator clips	

HW Options

High Impedance Probe ELQ P30	410-000-000
TDR measuring unit (built in).....	433-210-000
Loop closing device ELC 30.....	421-000-000
Car lighter power adapter EAA 10.....	367-000-000

Basic SW Options

PC control program.	SW 433-510-000
Interruption measurement	SW 433-530-000
SW Set for Spectrogram.....	SW 433-570-000
Spectrum Reference Template.....	SW 433-580-000
Spectral Trace as Reference	SW 433-550-000
Single ended loss meas.	SW 433-640-000

Voice Frequency SW Options

VF Group delay meas.....	SW 433-670-000
VF Jitter & fr. Difference meas.	SW 433-560-000
VF Echo meas.	SW-433-630-000
VF Event counter	SW 433-540-000

Advanced SW Options

ESEL Measurement.....	SW 433-600-000
ADSL ESEL Dependent Template.....	SW 433-610-000
ADSL DPBOMUS Template.	SW 433-620-000
ADSL Annex J.....	SW 433-700-000
VDSL DPBO Template.	SW-433-810-000
VDSL MUS Template.	SW-433-820-000
VDSL UPBO Template.	SW-433-900-000
VDSL Vectoring.	SW-433-910-000

Bridge SW Options

Loaded cable	SW-433-650-000
Multi section cable	SW-433-660-000

Others

Calibration Report for ELQ 30A	CR 433-000-000 E
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