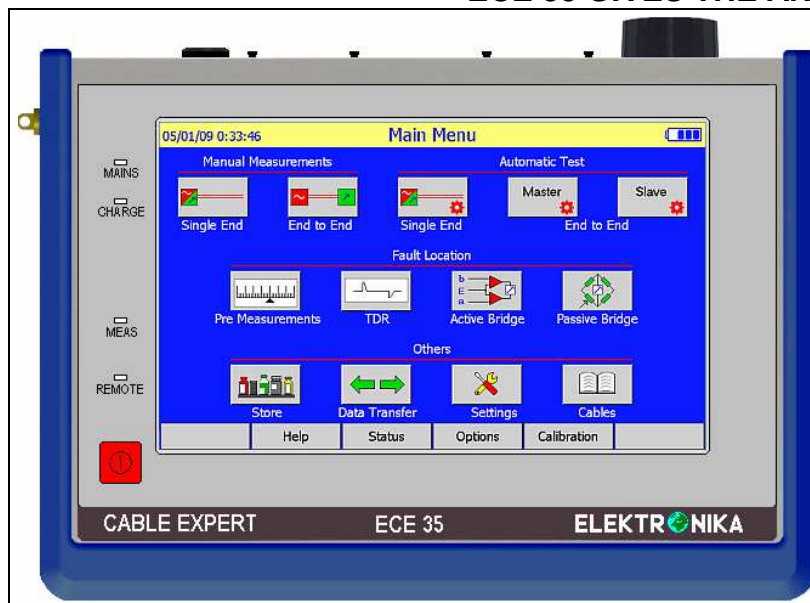


IS THIS PAIR SUITABLE FOR YOUR SYSTEM? IF NOT WHERE IS THE FAULT?



ECE 35 GIVES THE ANSWER!



**ECE 35** is an advanced hand-held instrument providing powerful tools for qualification and fault location of copper pairs used for various xDSL and voice frequency telecommunication services.

#### TWO INSTRUMENTS IN ONE

- Sophisticated Line Qualifier
- Precision Cable Fault Locator

#### TOOLS for LINE QUALIFICATION

- 35 MHz Transmitter
- 35 MHz Receiver
- 35 MHz Spectrum Analyzer
- Z, Return Loss, LCL measurements
- Phone Simulator

#### TOOLS for CABLE FAULT LOCATION

- Active Bridge & DMM
- Passive Wheatstone Bridge
- Graaf Fault Locator
- TDR

### LINE QUALIFICATION

#### MANUAL MEASUREMENTS

For the test of principal characteristics on xDSL and voice frequency lines

##### Single Sided Measurements

Impedance, Return Loss, LCL, NEXT, WB Noise, Impulse Noise, Spectrum Analyzer, Loss estimation for xDSL lines and Echo for VF lines

##### End to End Measurements

Loss, Interruption, Group Delay, Noise with Tone, Jitter and Frequ.-error, Simultaneous Event Counter

#### AUTOMATIC MASTER SLAVE TEST

Tolerance masks of cable parameters as Loss, LCL, Return Loss, Impedance, and the principal system parameters are pre-programmed for VDSL, ADSL, SHDSL, HDSL, ISDN, VF systems. In that mode ECE 35 provides:

##### Automatic Data Rate Calculation

##### Immediate PASS/FAIL indication

#### SPECIAL ADVANCED SW OPTIONS

##### Spectrogram

In that mode ECE 35 performs repeated spectrum measurements in every second and the obtained results are displayed up to 72 hours in the form of "water-fall" diagram. That method is an excellent tool to discover disturbers appearing in unpredictable times and frequency ranges.

##### Non disturbing test beside vectored groups

The operation of vectored group can be interrupted if the alien noise exceeds a certain limit therefore the traditional test methods are not applicable. ECE 35 provides non disturbing special test methods for the measurement beside vectored lines

### CABLE FAULT LOCATION

#### ACTIVE BRIDGE MEASUREMENTS

For accurate location of faults where the level of disturbing voltages are low.

##### DC Fault Location Methods

Murray, 3 Point, K upfm uller, Repeated K upfm uller and Resistance Difference

##### AC Fault Location Methods

Interruption, Repeated K upfm uller, C Balance

#### PASSIVE BRIDGE MEASUREMENTS

For accurate location of faults where the level of disturbing voltages are high.

##### DC Fault Location Methods

Murray, 3 Point, K upfm uller, R Difference

##### AC Fault Location Methods

K upfm uller, C Balance

#### GRAAF FAULT LOCATION

For fault location on totally water-soaked cable if the disturbing voltages are high and intermittent.

#### TDR MEASUREMENTS

To find low impedance faults and splits causing cross talk between the pairs.

##### Single Pair Modes

Short Time L1 or L2, Long Time L1 or L2

##### Double Pair Modes

XTALK, L1 & L2 or L1-L2

##### Memory Modes

Memory & L1 or Memory - L1

##### Automatic Configuration

For L1 and XTALK measurements

#### DMM MEASUREMENTS

Loop and Insulation resistance, Capacitance, AC/DC Voltage, DC Current  
Automatic Cable State Survey

**BASIC MEASURING MODES FOR LINE QUALIFICATION**

<p><b>Manual Measuring Modes</b></p> <ul style="list-style-type: none"> <li>• Transmitting</li> <li>• Selective Receiver</li> <li>• Wideband Receiver</li> <li>• NEXT</li> <li>• LCL Balance</li> <li>• Impedance</li> <li>• Return loss</li> <li>• Wideband Noise</li> <li>• Impulse Noise</li> <li>• Micro Interruption Analysis</li> <li>• Spectrum Analyzer</li> <li>• Single End Loss Estimation</li> </ul>	<p><b>Automatic Master/Slave xDSL Line Test (DELTA)</b></p> <ul style="list-style-type: none"> <li>• Templates for SVDSL, VDSL2, ADSL2+, ADSL2, ADSL, READSL, SHDSL HDSL and ISDN systems</li> <li>• Loss, Noise, Impedance, Return Loss, Balance, NEXT and FEXT measurements</li> <li>• Bit load &amp; Achievable bit rate calculation</li> </ul> <p><b>Automatic Master/Slave VF Line Test (DELTA)</b></p> <ul style="list-style-type: none"> <li>• Templates for Active, Passive and Switched voice frequency lines</li> <li>• Loss, Noise, Total Distortion, Impedance, Return Loss, Balance, NEXT and FEXT measurements</li> </ul>
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**SW OPTIONS FOR LINE QUALIFICATION**

<p><b>Spectral Trace as Reference</b></p> <ul style="list-style-type: none"> <li>• Stored spectrum as reference and</li> <li>• System dependent PSD as reference</li> </ul> <p><b>Spectrogram</b></p> <ul style="list-style-type: none"> <li>• Repeated spectrum measurements in every second up to 72 hours</li> </ul> <p><b>Test Beside Vectored Groups</b></p> <ul style="list-style-type: none"> <li>• Non-disturbing test beside VDSL2 groups.</li> <li>• Non-disturbing test beside SVDSL groups</li> </ul>	<p><b>Automatic Single Ended xDSL Line Test (SELT)</b></p> <ul style="list-style-type: none"> <li>• Single End Loss, Noise estimation,</li> <li>• Bit load &amp; Achievable bit rate estimation</li> <li>• Impedance, Return Loss, Balance, NEXT</li> </ul> <p><b>Voice frequency SW package</b></p> <ul style="list-style-type: none"> <li>• Noise with tone measurement</li> <li>• Group delay distortion measurement</li> <li>• Phase jitter and Frequ. error measurement</li> <li>• Simultaneous Event counters</li> <li>• Echo test</li> </ul>
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**ACTIVE BRIDGE FOR CABLE FAULT LOCATION (Built in HW Option)**

<p><b>DC Fault Location</b></p> <ul style="list-style-type: none"> <li>• Loop Resistance</li> <li>• Resistance Difference</li> <li>• Insulation Resistance</li> <li>• Murray,</li> <li>• 3 Point,</li> <li>• K�pfm�ller</li> <li>• Repeated K�pfm�ller</li> </ul> <p><b>AC Fault Location</b></p> <ul style="list-style-type: none"> <li>• Capacitance</li> <li>• Capacitive Balance</li> <li>• Interruption</li> <li>• Repeated K�pfm�ller</li> </ul> <p><b>Telephone Simulator</b></p>	<p><b>TDR</b></p> <ul style="list-style-type: none"> <li>• Single Pair</li> <li>• Double Pair</li> <li>• Comparison to Memory</li> </ul> <p><b>DMM</b></p> <ul style="list-style-type: none"> <li>• AC DC Voltage</li> <li>• DC Current</li> <li>• Resistance</li> <li>• Insulation Resistance</li> <li>• Capacitance</li> </ul> <p><b>Automatic Test Sequences</b></p> <ul style="list-style-type: none"> <li>• Quick Test</li> <li>• Quality Test</li> <li>• Pair Condition Survey</li> </ul>
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**EXTENSIONS FOR ACTIVE BRIDGE**

<p><b>PASSIVE BRIDGE (Built in HW Option)</b></p> <ul style="list-style-type: none"> <li>• DC Fault Location</li> <li>• Loop Resistance</li> <li>• Resistance Difference</li> <li>• Insulation Resistance</li> <li>• Murray, 3 Point, K�pfm�ller, Synchronous Graaf Method</li> </ul> <p>AC Fault Location</p> <ul style="list-style-type: none"> <li>• Capacitive Balance, K�pfm�ller</li> </ul> <p><b>TEST OF LOADED CABLES (SW Option)</b></p> <p><b>TEST OF MULTI SECTION CABLES (SW Option)</b></p>
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**SPECIFICATIONS OF LINE QUALIFIER FUNCTIONS**

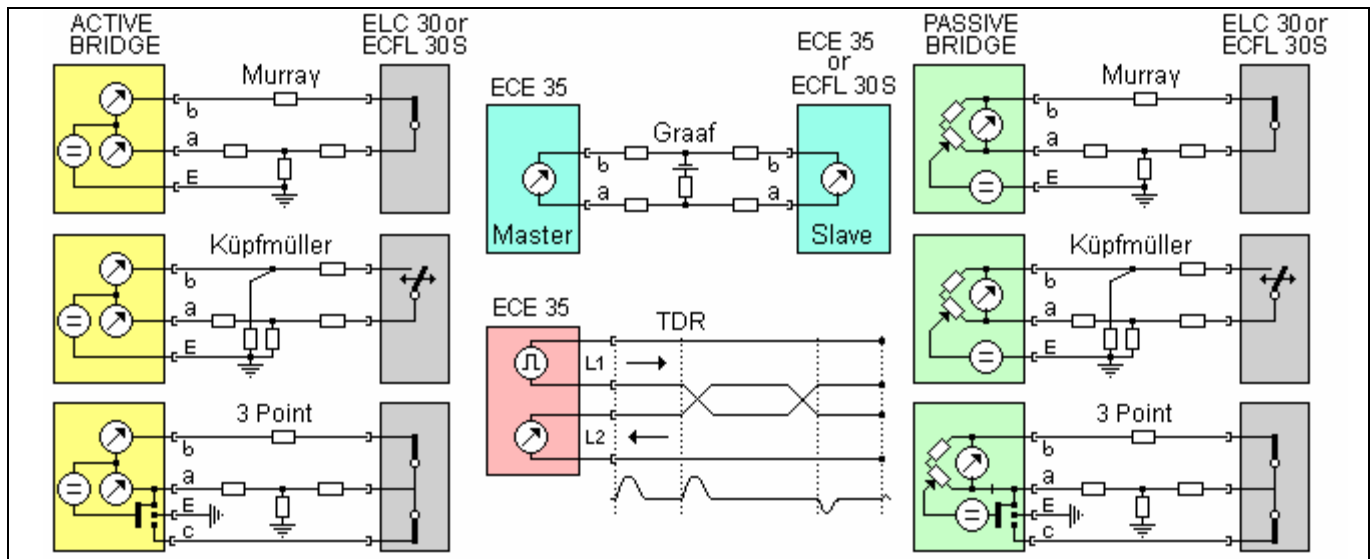
<p><b>Transmitter</b></p> <p>Outputs (Balanced)                  10 kHz to 30 MHz ..... 100, 135, 150 Ω                  200 Hz to 10 kHz ..... 600 Ω</p> <p>Frequency                  Frequency Range ..... 200 Hz to 35 MHz                  Frequency resolution ..... 1 Hz                  Frequency accuracy ..... <math>2 \times 10^{-6} \pm 1</math> Hz</p> <p>Transmitting modes ..... One frequency/MTTS/Sweep</p> <p>Output level                  10 kHz to 35 MHz ..... +10 to -40 dBm                  200 Hz to 10 kHz ..... +4 to -45 dBm                  Level Resolution ..... 0.1 dB</p> <p>Accuracy at 0 dBm                  200 Hz to 10 kHz ..... ±0,5 dB                  10 kHz to 5 MHz ..... ±0.3 dB                  5 MHz to 35 MHz ..... ±1 dB</p> <p><b>Receiver</b></p> <p>Inputs (Balanced)                  10 kHz to 35 MHz ..... 100, 135, 150 Ω or High                  200 Hz to 10 kHz ..... 600 Ω or High</p> <p><b>Selective Level Measurement</b></p> <p>Frequency                  Frequency Range ..... 200 Hz to 35 MHz                  Frequency resolution ..... 1 Hz                  Frequency accuracy ..... <math>2 \times 10^{-6} \pm 1</math> Hz</p> <p>Receiving modes ..... One frequency/MTTS/Sweep</p> <p>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 35 MHz ..... 1.74, 1.95, 3.1 kHz</p> <p>Measuring Range                  10 kHz to 35 MHz ..... -120 to +10 dBm                  200 Hz to 10 kHz ..... -120 to +4 dBm                  Level Resolution ..... 0.1 dB</p> <p>Accuracy at 0 dBm                  200 Hz to 10 kHz ..... ±0,5 dB                  10 kHz to 5 MHz ..... ±0.3 dB                  5 MHz to 30 MHz ..... ±1.5 dB</p> <p><b>Wideband Level Measurement</b></p> <p>Frequency Range ..... 200 Hz to 35 MHz</p> <p>Measuring Range                  10 kHz to 35 MHz ..... -50 to +10 dBm                  200 Hz to 10 kHz ..... -50 to +4 dBm                  Level Resolution ..... 0.1 dB</p> <p>Accuracy at 0 dBm                  200 Hz to 10 kHz ..... ±0,5 dB                  10 kHz to 5 MHz ..... ±0.3 dB                  5 MHz to 35 MHz ..... ±1.5 dB</p>	<p><b>Spectrum Analyzer</b></p> <p>Frequency range ..... 200 Hz to 35 MHz</p> <p>Line impedances                  10 kHz to 30 MHz ..... 100, 135, 150 Ω or High                  200 Hz to 10 kHz ..... 600 Ω or High</p> <p>Display range ..... down to -140 dBm/Hz</p> <p>Maximum input level                  200 Hz to 10 kHz ..... +4 dBm                  10 kHz to 35 MHz ..... +10 dBm                  With high impedance active probe ..... +20 dBm</p> <p>Bandwidth and frequency step</p> <table border="1"> <thead> <tr> <th>Frequency Range</th> <th>Bandwidth &amp; Freq. Step</th> </tr> </thead> <tbody> <tr> <td>35 MHz</td> <td>500 Hz to 120 kHz</td> </tr> <tr> <td>30 MHz</td> <td>500 Hz to 120 kHz</td> </tr> <tr> <td>18 MHz</td> <td>500 Hz to 60 kHz</td> </tr> <tr> <td>12 MHz</td> <td>500 Hz to 40 kHz</td> </tr> <tr> <td>9 MHz</td> <td>500 Hz to 30 kHz</td> </tr> <tr> <td>3 MHz</td> <td>500 Hz to 10 kHz</td> </tr> <tr> <td>1.5 MHz</td> <td>500 Hz to 5 kHz</td> </tr> <tr> <td>600 kHz</td> <td>500 Hz to 2 kHz</td> </tr> <tr> <td>300 kHz</td> <td>500 Hz to 1 kHz</td> </tr> <tr> <td>20 kHz</td> <td>50 Hz to 100 Hz</td> </tr> <tr> <td>4 kHz</td> <td>10 Hz to 20 Hz</td> </tr> <tr> <td>0.3 kHz</td> <td>1 Hz</td> </tr> </tbody> </table> <p>Number of displayed frequencies ..... 300                  Saving of result ..... the actual content of display                  Evaluation ..... NORM, PEAK, AVG, SAVG                  Units ..... dBm, dBm/Hz</p> <p><b>LCL Measurement</b></p> <p>Impedance                  10 kHz to 35 MHz ..... 100, 135, 150 Ω                  200 Hz to 10 kHz ..... 600 Ω</p> <p>Display range ..... 0 to 70 dB</p> <p>Accuracy at 35 dB                  200 Hz to 100 kHz ..... ±2 dB                  100 kHz to 5 MHz ..... ±1 dB                  5 MHz to 30 MHz ..... ±2,5 dB</p> <p><b>Impedance Measurement</b></p> <p>Measuring range                  10 kHz to 35 MHz ..... 50 to 400 Ohm                  200 Hz to 10 kHz ..... 300 to 1600 Ohm</p> <p>Accuracy                  200 Hz to 10 kHz ..... ± 10% ± 5 Ohm                  10 kHz to 18 MHz ..... ±5% ± 5 Ohm                  18 MHz to 30 MHz ..... ±10% ± 5 Ohm</p> <p><b>Return Loss Measurement</b></p> <p>Impedance                  10 kHz to 35 MHz ..... 100, 135, 150 Ω                  200 Hz to 10 kHz ..... 600 Ω</p> <p>Display range ..... 0 to 40 dB</p> <p>Accuracy at 20 dB                  200 Hz to 18 MHz ..... ±2 dB</p>	Frequency Range	Bandwidth & Freq. Step	35 MHz	500 Hz to 120 kHz	30 MHz	500 Hz to 120 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
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0.3 kHz	1 Hz																										

<p><b>Next Measurement</b>                  Frequency range ..... 200 Hz to 35 MHz                  Impedances                      10 kHz to 35 MHz..... 100, 135, 150 Ω Balanced                      200 Hz to 10 kHz..... 600 Ω Balanced                  Measuring modes ..... One frequency, Sweep                  Measuring range ..... up to 80 dB</p> <p><b>Wideband Noise Measurement</b>                  Frequency range ..... 200 Hz to 35 MHz                  Filters for noise Measurements ..... Psophometric                      3,1 kHz Flat, 1020 Hz Notch                      ADSL, ADSL 2+, VDSL 1                      VDSL 2-8, VDSL 2-12,                      VDSL 2-17, VDSL 2-30, SVDSL-35                  Measuring time ..... selectable 1sec to 72 hours                  Evaluation ..... For 1 sec to 1 min quasi analogue                  Over 1 min ..... Histogram with 60 time slots</p> <p><b>Impulse Noise Measurement</b>                  Pulse width ..... &gt;500 ns                  Interval size ..... 10 ms                  Threshold range ..... 1 to 500 mV                  Maximum count ..... 65000                  Measuring time ..... selectable 1sec to 72 hours                  Evaluation ..... For 1 to 30 sec numeric                  Over 30 sec ..... Histogram with 60 time slots</p> <p><b>Micro Interruption Measurement</b>                  Test signal ..... 1020 Hz, 0 to -30 dBm                  Impedance ..... 600 Ω                  Threshold below the normal level .... 3, 6, 10, 20 dB                  Accuracy of Threshold                      For 3, 6, 10 dB ..... ± 1 dB                      For 20 dB ..... ± 2 dB                  Measuring time ..... selectable 4min to 72 hours                  Interruption Categories ..... 0.6 ms to &gt;1 min                  Evaluation ..... Relative duration, Errored sec                      Count &amp; time distribution / category</p> <p><b>Single-End Insertion Loss Measurement</b>                  Frequency ranges ..... 1.5, 3, 9, 12, 18, 30, 35 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                  (The accuracy and the maximum length depend on the cable conditions)</p>	<p><b>Simultaneous Event Counting</b>                  Measurement times ..... 5, 15, 30, 60 min                  Test signal ..... 1020 Hz, 0 to -30 dBm                  Maximum counts for each counter ..... 65000  <u>Amplitude Hit Counter (O.95)</u>                  Threshold range ..... 2 to 9 dB                  Guard interval ..... 4 ms                  Dead time ..... 125 ± 25 ms                  Dead time after interruption (&gt;10 dB drop) ..... 1 s  <u>Phase Hit Counter (O.95)</u>                  Threshold range ..... 5 to 45 °                  Guard interval ..... 4 ms                  Dead time ..... 125 ± 25 ms  <u>Interruption Counter (O.61)</u>                  Threshold ..... 6, 10 dB                  Guard interval ..... 2 ms                  Dead time ..... 3 ± 1 ms  <u>Impulsive Noise Counter (O.71)</u>                  Filter ..... 1020 Hz Notch                  Guard interval ..... 20 µs                  Dead time ..... 125 ± 25 ms                  Threshold range ..... 0 to -50 dBm</p> <p><b>Group Delay Distortion (O.81 app. I)</b>                  Test signal ..... 36MTT, 200 to 3700 Hz                  Output level ..... -20 dBm/tone (3dBm peak)                  Input level range ..... -50 to -10 dB/tone                  Group delay distortion range ..... 0 to 5 ms                  Resolution ..... 1 µs</p> <p><b>Phase Jitter &amp; Frequ. Error Measurement (O.91)</b>                  Test signal ..... 1020 Hz, 0 to -30 dBm                  Range ..... 0.2 to 30.0 degrees p-p                  Filter ..... 4 to 300 Hz</p> <p><b>Telephone Simulator</b>                  Dialing ..... Pulse &amp; Tone                  Storage of phone numbers ..... Provided  <u>Indications</u>                  Line voltage ..... up to 100V                  Line current ..... up to 100 mA                  Ringing voltage ..... up to 100V p-p</p> <p><b>Echo Test</b>                  Measuring range ..... 0 to 2500 ms                  Resolution ..... 5 ms                  Display range ..... 0 to -90 dB</p>
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**DATA TRANSFER**

<p><b>Data transfer via USB port</b>                  The USB port provides:</p> <ul style="list-style-type: none"> <li>• bidirectional transfer of test results</li> <li>• bidirectional transfer of test setups</li> <li>• transfer of print screen images to USB stick</li> <li>• transfer of upgrade files to ECE 35</li> </ul>	<p><b>Data transfer via WiFi</b>                  The WiFi connection provides two ways of transferring test results, test setups and images to LAN network:</p> <ul style="list-style-type: none"> <li>• ECE 35 initiates a connection to a FTP server</li> <li>• ECE 35 acts as a HTTP server</li> </ul>
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FAULT LOCATOR MODES



SPECIFICATIONS OF FAULT LOCATOR FUNCTIONS

TDR

ACTIVE BRIDGE

Measuring Modes

Single Pair..... L1, L2, L1 long time, L2 long time  
 L1 with automatic configuration  
 Double Pair .....L1& L2, L1-L2, XTALK  
 XTALK with automatic configuration  
 Memory Modes ..... L1& Memory, L1- Memory

Measuring Ranges

For non loaded cable (at V/2=100) ..... up to 32 km  
 For loaded cable (at V/2=10) ..... 6.4 to 32 km  
 The maximum range depends on cable condition

Evaluation of Results

With Cursor and Marker ..... In meters  
 Refreshing of waveform ..... ~4/sec  
 Zoom ..... Maximum 16

Accuracy

Fault location .....0.2% of range  
 Resolution ..... 0.01 m

Propagation Velocity

For non loaded cables  
 V/2 ..... 45 to 149 m/µs  
 VOP ..... 30 to 99 %  
For loaded cables  
 V/2 ..... 1.2 to 30 m/µs  
 VOP ..... 0.8 to 20 %

Pulse Characteristics

Widths for non loaded cable ..... 4 ns to 6 µs  
 Widths for loaded cable ..... 330 µs  
 Amplitude: ..... 1.3 to 12 Vpp in 120 Ω  
 Automatically changed  
 with gain and width.

Line Connection

Impedance ..... 120 Ω balanced  
 Balance control ..... 50 to 270 Ω

Gain Control

Range ..... 0 to 90 dB  
 Steps ..... 6 dB/Step

Distance Dependent Amplitude Correction

Number of steps ..... 10

Voltage

DC voltage ..... up to 400 V  
 AC voltage ..... up to 250 V eff  
 Accuracy ..... ±3% ±1 V  
 Frequency range ..... 15 to 300 Hz  
 Input resistance ..... 2 M Ω

Loop Resistance

Measuring range ..... 1 Ω to 10 kΩ  
 Accuracy ..... ±0.3% ±0.1 Ω

Resistance Difference

Loop resistance range ..... 10 Ω to 5000 Ω  
 Accuracy ..... ±0.2% of RI ±0.2 Ω

Insulation Resistance

Measuring range ..... 10 kΩ to 300 MΩ  
 Measuring voltage ..... 100 / 250 V  
 Accuracy ..... 2 to 5% ±1 kΩ

Capacitance

Measuring range ..... 1 nF to 2 (10) µF  
 Measuring voltage ..... 11 Hz, 100 V  
 Accuracy ..... ±2% ±0.2 nF

Capacitive Balance

Measuring range ..... 1 nF to 2000 nF  
 Measuring voltage ..... 11 Hz, 100 V  
 Accuracy of Lx/L value ..... ±0.2 %

DC Fault Location

Test Methods ..... Murray, Küpfmüller, 3 Point  
 Loop resistance range ..... 1 Ω to 10 kΩ  
 Fault resistance range ..... up to 100 MΩ  
 Measuring voltage ..... 100 V  
 Accuracy (RI=2 kΩ, Lx/L=0,1 to 1)  
 Fault resistance < 1MΩ ..... ± 0.2 %  
 Fault resistance 1 MΩ to 5 MΩ ..... ± 0.3 %  
 Fault resistance 5 MΩ to 25 MΩ ..... ± 0.5 %  
 Fault resistance 25 MΩ to 100 MΩ ..... ± 2 %

AC Fault Location Interruption

Range ..... up to 20 km (Depends on cable typ)  
 Accuracy ..... ±2% ±0.2 nF



**PASSIVE BRIDGE**

**PRE MEASUREMENTS**

<p><b>Loop Resistance</b>                  Measuring range ..... 1 Ω to 10 kΩ                  Accuracy..... ±0.3% ±0.3 Ω</p> <p><b>Insulation Resistance</b>                  Measuring ranges                  Measuring ranges ..... 10 kΩ to 300 MΩ                  10 kΩ to 10 GΩ                  Measuring voltage ..... 100 V                  Accuracy                  10 kΩ to 50 MΩ ..... 5 % ± 1 kΩ                  50 MΩ to 100 MΩ..... 10 %                  100 MΩ to 5 000 MΩ..... 20 %                  5 000 MΩ to 10 000 MΩ..... 30 %</p> <p><b>Resistance Difference</b>                  Loop resistance range..... 1 Ω to 5000 Ω                  Accuracy..... ±0.2% of RI ±0.2 Ω                  Resolution of Lx/L (Mk)-value                  In range ΔR &lt;10%..... 1/10000                  In range ΔR &gt;10%..... 1/1000</p> <p><b>DC Fault Location</b>                  Test methods..... Murray, Küpfmüller, 3 Point                  Loop resistance range..... 1 Ω to 10 kΩ                  Fault resistance range..... up to 100 MΩ                  Measuring voltage ..... 100 V                  Accuracy (RI=2 kΩ, Lx/L=0,1 to 1)                  Fault resistance &lt; 1 MΩ..... 0.2 %                  Fault resistance 1 MΩ to 5 MΩ ..... 0.3 %                  Fault resistance 5 MΩ to 25 MΩ ..... 0.5 %                  Fault resistance 25 MΩ to 100 MΩ ..... 2 %                  Resolution of Lx/L (Mk) value..... 1/1000</p> <p><b>AC Fault Location Küpfmüller Method</b>                  Loop resistance range..... 1 Ω to 10 kΩ                  Fault resistance range..... up to 25 MΩ                  Measuring voltage ..... 11 Hz, 100 V                  Accuracy (RI=2 kΩ, Lx/L=0,1 to 1)                  Fault resistance &lt; 1 MΩ..... ±0.3%                  Fault resistance 1 MΩ to 5 MΩ ..... ±0.5%                  Fault resistance 5 MΩ to 25 MΩ ..... ±1.0%                  Resolution of M value ..... 1/1000</p> <p><b>AC Capacitive Balance</b>                  Measuring range. .... 10 nF to 2000 nF                  Accuracy of Lx/L value ..... ±0.2%                  Measuring voltage ..... 11 Hz, 100 V                  Resolution of Lx/L value                  In range Lx/L=0.9 to 1.1 ..... 1/10000                  In range Lx/L&lt;0.9 or Lx/L&gt;1.1 ..... 1/1000</p> <p><b>Fault Location Graaf Method</b>                  Loop resistance range..... 10 Ω to 10 kΩ                  DC current range..... 10μA to 1A                  Accuracy of current measurement ..... ±0.3% ±2μA                  Accuracy of Lx/L value (current &gt;0.1mA) ..... ±3%                  Accuracy of Lx/L value (current &gt;1mA) ..... ±0.3%</p>	<p><b>Disturbing Voltage</b>                  Measuring mode..... Repeated measurement                  DC voltage. .... up to 400 V                  AC voltage ..... up to 250 V eff                  Accuracy..... ±3 % ± 1 V                  Frequency range ..... 15 to 300 Hz                  Input resistance ..... 2 MΩ</p> <p><b>Loop Resistance</b>                  Measuring mode..... Repeated measurement                  Measuring range..... 1 Ω to 10 kΩ                  Accuracy ..... ±0.5 % ±0.2 Ω</p> <p><b>Insulation Resistance</b>                  Measuring mode..... Repeated measurement                  Measuring range. .... 10 kΩ to 300 MΩ                  Measuring voltage ..... 100 V                  Accuracy ..... 20 %</p> <p><b>DC Current</b>                  Measuring range. .... 10μA to 1A                  Accuracy..... ±0.5 % 0.1 μA</p> <hr/> <p><b>AUTOMATIC QUICK TEST</b></p> <p><b>Disturbing Voltage</b>                  Measuring range..... up to 400 V DC, 250 V AC                  Test results ..... Vab, VaE and VbE</p> <p><b>Insulation</b>                  Measuring range..... 10 kΩ to 300 MΩ                  Measuring voltage ..... 100 V</p> <p><b>Capacitance</b>                  Measuring range..... 10 to 2000 nF</p> <p><b>Capacitive Balance</b>                  Test result ..... Unbalance %                  Measuring voltage ..... 11 Hz, 100 V</p> <hr/> <p><b>AUTOMATIC QUALITY TEST</b></p> <p><b>Insulation</b>                  Measuring range..... 10 kΩ to 10 000 MΩ</p> <p><b>Capacitance</b>                  Measuring range..... 10 to 2000 nF</p> <p><b>Capacitive Balance</b>                  Test result ..... Unbalance %                  Resolution..... 1/1000</p> <p><b>Loop Resistance</b>                  Measuring range..... 1 Ω to 10kΩ                  Accuracy ..... ±0.3% ±0.1 Ω</p> <p><b>Resistance Difference</b>                  Loop resistance range ..... 10 Ω to 5 kΩ                  Resolution..... 1/1000</p> <hr/> <p><b>PAIR CONDITION SURVEY</b></p> <p>The Survey of Pair Condition is extremely useful test sequence to find the best fault location method.                  The consists of the following measurements:</p> <ul style="list-style-type: none"> <li>• <b>Disturbing voltage</b></li> <li>• <b>Capacitance</b></li> <li>• <b>Loop and wire resistances</b></li> <li>• <b>Insulation resistances</b></li> </ul>
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**LOOP CLOSING DEVICE ELC 30 (HW OPTION)**

**Functions**

Opening or closing the far end of tested pair when just one person wants to perform a measurement during which the far endings should be opened or closed (e.g. Küpfmüller method).

The device is remote controlled over the tested pair by ECE 35



**Specifications**

**Power supply**

AA size alkaline battery cells..... 3 pieces  
 Operation time ..... ca. 1000 hours  
 Auto power off ..... 4 hours

**Connectors**.....4 mm banana plugs

**Mechanical Data**

Dimensions..... 110 x 60 x 25 mm  
 Weight (Including battery pack).....ca. 0,2 kg

**INTELLIGENT SLAVE ECFL 30S (HW OPTION)**

**Functions**

Opening or closing the far end of tested pair when just one person wants to perform a measurement during which the far endings should be opened or closed (e.g. Küpfmüller method).

Current measurement at the far end of the tested pair when Graaf method is applied. In case of Graaf method the master ECE 35 and the remote controllable intelligent slave ECFL 30S measure the current at the two cable ends at the same time and communicate over the tested pair. The Master calculates the location of fault out of the rate of currents



**Specifications**

**Power Supply**

AA size alkaline battery cells..... 4 pieces  
 Operation time ..... ca. 500 hours  
 Auto power off ..... 4 hours

**Connectors**

A, B, C line connectors..4 mm banana sockets  
 Ground connector.....4 mm banana socket

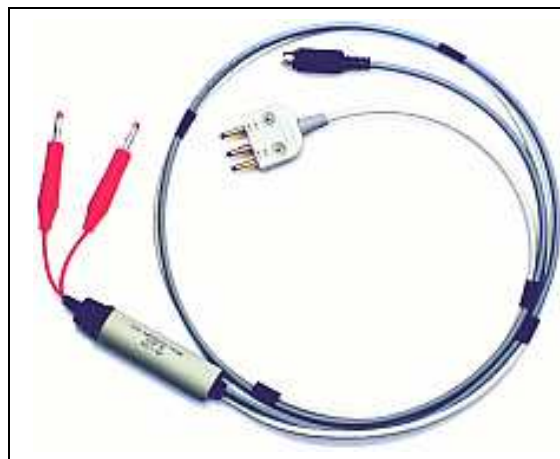
**Mechanical Data**

Dimensions..... 210 x 100 x 40 mm  
 Weight (Including battery pack).....ca. 0,4 kg

**Control**

The device is remote controlled over the tested pair by ECE 35

**HIGH IMPEDANCE PROBE ELQP 30 (HW option)**



**Purpose**

The ELQP 30 active probe is intended for PSD spectrum measurement on working lines when test instrument should be connected parallel with the operating modems and the regular measuring cables can not be used because the digital systems are extremely sensitive for the capacitive load

**Specifications**

Frequency range ..... 5 kHz to 30 MHz  
 Attenuation ..... 15 dB  
 Input Impedance..... 5 kOhm || 5pF  
 Accuracy  
 5 kHz to 25 kHz .....±1dB  
 25 kHz to 5 MHz .....±0.3 dB  
 5 MHz to 30 MHz .....±1dB  
 Powered .....from ECE 35

**GENERAL SPECIFICATIONS**

**ORDERING INFORMATIONS**

**Power Supply**

Internal rechargeable Lithium Ion battery pack  
 Operation time..... approx. 8 hours  
 Charging (without taking the battery pack out)  
 From 100 to 240 V mains ..... with mains adapter  
 From 12 V car battery ..... with car adapter  
 Charging time ..... ~ 3 hours  
 Display ..... 800 x 480 color LCD TFT  
 Connector for mains adapter ..... 2.1/5.5 mm coax

**Connectors for Bridge Measurements**

Ground connector ..... 4 mm banana socket  
 Line connectors ..... 4 pcs of 4 mm banana sockets

**Connectors for Line Qualification**

Ground connector ..... 4 mm banana socket  
 Line connectors ..... 2 pcs of 3 pol CF sockets

**Connectors for Data Transfer**

USB A ..... USB 1.1 host port for USB-Stick

**Over Voltage Protection**

Between a and b  
 Fault locator ..... 500 V DC, 350 V AC  
 Line qualifier ..... 200V DC 160V AC

**Ambient temperature ranges**

Reference ..... 23±5°C  
 Rel. humidity 45% to 75%\*  
 Normal operation ..... 0 to +40°C  
 Rel. humidity 30% to 75% \*( $<25\text{g/m}^3$ )  
 Limits of operation ..... -5 to +45°C  
 Rel. humidity 5% to 95% \*( $<29\text{g/m}^3$ )  
 Storage and transport ..... -40 to +70°C  
 Rel. humidity 95% at +45°C \*( $<35\text{g/m}^3$ )  
 Protection ..... IP 54

**Memory Locations**

For test results ..... 50  
 For cable parameter ..... 50

**Dimensions**

Without bridge ..... 224 x 160 x 65 mm  
 With bridge ..... 224 x 160 x 75 mm

**Weight**

Without bridge ..... ca. 1.5 kg  
 With bridge ..... ca. 1.8 kg

\* Without condensation

**CABLE EXPERT ECE 35 ..... 460-000-000**

**Including:**

Operating manual set & Calibration Certificate  
 Test lead (green)  
 2 Balanced Measuring Cables  
 USB stick  
 Mains adapter  
 Carrying case

**HW options**

High Impedance Probe ELQ P30 ..... 410-000-000  
 Loop closing device ELC 30 ..... 421-000-000  
 Intelligent Slave ECFL 30S ..... 425-000-000  
 Car lighter power adapter EAA 20 ..... 462-000-000

**SW options for xDSL line qualification**

Single End Line Test ..... SW 460-640-000  
 Single-End loss estimation and  
 Automatic line test with data rate estimation  
 Test Beside Vectored Groups ..... SW-460-910-000  
 Non-disturbing test beside VDSL2 groups.  
 Non-disturbing test beside 35 MHz Vplus groups.  
 Spectrogram Measurement ..... SW 460-570-000  
 Spectral Trace as Reference ..... SW 460-950-000  
 Stored spectrum as reference and  
 System dependent PSD as reference

**SW option for voice frequency measurements**

VF Line qualification ..... SW 460-940-000  
 Group delay, Jitter & Frequ Difference,  
 Noise with tone measurements,  
 Event counter, Echo Test

**Built in HW options**

Active bridge, DMM, and TDR ..... 460-400-000  
 2-wire test lead (red/black)  
 2-wire test lead (blue/yellow)  
 Passive bridge ..... 460-460-000  
 Extension for Active Bridge

**SW options for bridge measurement**

Test of loaded cables ..... SW-460-650-000  
 Test of multi section cables ..... SW-460-660-000