aTen
SISTEMI ELETTRONICI

ACT6000

Advanced Communication Tester

User Guide

Revision Advanced 1.18

July 2013

ACT000

Advanced Communication Tester

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1 General description

The **ACT6000** combines various kinds of transmission, metallic and special tests. It can be considered to be the most advanced Test Set today for qualifying and maintenance of advanced transmission systems and copper pairs used for various telecommunication services: from POTS to ADSL and VDSL.

One of **ACT6000's** most interesting features is the new high resolution color graphic display, a real "window" on the most advanced measurements' world.
The alphanumeric keypad, as well as the function-keys, grant to the instrument a high operating level. Moreover, take note that, due to its accurate and intuitive "Human Machine and Graphics User Interface", this instrument needs the help of the user's manual to arrange and carry out unusual measurements and/or settings.

One **ACT6000**, suitably configured, can perform easily and quickly "Single-End Tests" or very accurate "End-to-End Tests" together with another **ACT6000**. The wide range of measurements of the **ACT6000** allows the qualification and certification of various communication carriers and copper pairs used for digital streams with a frequency span up to 6 MHz (or 30 MHz optional); moreover, the instrument can automatically extrapolate the ADSL and VDSL maximum expected data rate of the copper line under test.

ACT6000 can be configured for in-depth analysis, by special functions and internal optional modules. The complete adoption of these modules allows the simple and fast finding of anomalies and/or faults on the copper line and communication systems.

Package

The package of the instrument (base version) contains: the carrying case, this guide, the AC / DC battery-charger, Banana/Crocodile cable and Ground Cable. Make sure that, on receipt, this pack and its contents have not been damaged by bumps or careless handling. For possible shipment of the instrument for repair or calibration it is suggested to use the original pack.

Instrument identification

The Part-Number, Serial Number, Hardware Configuration, and date of production or Calibration are pointed out on the factory label applied on the rear panel.

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2 Safety and conformity information

The ACT6000 is intended for use by qualified personnel only.

The use of this tester is allowed in internal or external environments within the normal human range of climatic characteristics (temperature and damp. It is recommended to work with this tester within declared temperature limits (0 - 50°) and not in contact with water, because it is not waterproof.

The ACT6000, like all the ATEN instruments, is "CE" certified for full electromagnetic compatibility and safety. The stage In/Out (RTX connector) of the ACT6000 is designed for use with circuits that have a maximum of 150 Vdc or peak AC wire-to-wire, or 75 Vdc or peak AC wire-to-ground.

Warning ! The stage output of the instrument "TX connector" is not protected !

Failure to comply with these precautions or with specific warnings in this guide violates the safety standards of design, manufacture, and intended use of the tester.

ATEN S.r.l. assumes no liability for the customer's failure to comply with these requirements. If this product is used in a manner not specified by the ATEN S.r.l. the protections provided by the product may be impaired.

The **RTX** connector of the ACT6000 has an automatic protection device to protect against over-voltage; over specified limits the protection activates and on the following message appears on the display :

WARNINGS!

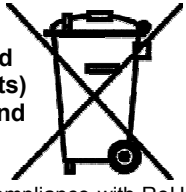
OVER VOLTAGE PROTECTION

VERIFY LINE CONNECTIONS - PUSH ANY KEY TO RESTORE

To restore the operation of the instrument, after verifying the correct state of the line, press any key. In every case, to ensure correct galvanic isolation of the instrument during the execution of high impedance measurements Insulation or DC capacitance, disconnect from the instrument: **External AC/DC Battery Charger.**

3 Community directive 2002/96/EC

Community directive 2002/96/EC for introduction in the market and to disposal of "WEEE" (waste electrical and electronic equipments) containing "RoSH" materials damaging to the environment and detrimental to human health.



ATEN declare that all the materials, components, products supplied are fully compliance with RoHS & Weee Directives. Nevertheless, the disposal of this equipment cannot be disposed as waste but it has to be returned to the producer or to its official distribution network which will arrange to carry out a separate collection.
In order to comply with what is mentioned above is stated that:
- even if the equipment does not contain dangerous elements listed on RoHS directives, improper use could be detrimental to human health and damaging to the environment;
- the meaning of the symbol shown below and affixed on the equipment is to remind that the same cannot be disposed of as "waste";
- penalties are to be expected in case of an abusive disposing of the equipment.

4 Functions and measurements type

4.1 Functions

The main functions of the ACT6000 are:
- Generator and Meter;
- Spectrum and Network Analyzer;
- TDR fault locator.

To the above are added the following functions:

- DMM plug & play module, for metallic measurements (AC/DC Voltage, DC Resistance and AC/DC Capacitance).

- POTS-SUB plug & play module, for manual Subscribe Simulator and automatic End-to-End test on POTS lines *with the ASW 2 **.

- Instrument Configuration (General Setup, Display, Date, Hour, USB ports, Software up-date etc.)

- File Manager utility for files storage, management and export.

4.2 Measurement types

● **Automatic measurements** on pre-configured transmissive masks (ETSI or ANSI):

- Single-End automatic test for copper pair pre-qualification *with the ASW 1*;*
- End-to-End automatic tests for copper pair qualification *with the ASW 2**.

- "Slave" configuration for the End-to-End tests on copper pairs and POTS lines *with the ASW 2**.

● **Transmissive measurements:**

- Signal and white noise generation
- Selective Level and Frequency measurements
- Noise measurement (wide and weighted band)
- Power Spectral Density
- Return Loss measurement
- Longitudinal Balance Loss measurement
- Crosstalk Loss measurement
- Insertion Loss measurement
- S/N and Distortion (on base band) measurement

*Note * ASW 1 / 2: optional Advanced Software.*

● **Events test:**

- Impulsive Noise long term measurement
- Micro-interruptions long term measurement

- AC – DC Voltage
- AC – DC Capacitance
- DC – Resistance and Insulation
- DC – Resistance Balancement
- RFL to Low insulation finding

● **TDR Fault location:**

- TDR real time measurement for faults and line length location.
- TDR long term measurement to intermittent faults location.

4.3 Measure Saving & Export (release **1.18**).

All the results of the performed measurements can be saved on internal memory exportable to the external USB Pen-Drive in **.CSV** format.
The CSV files are compatible with the Windows Excel application to visualize and to edit graphics and data base.
On the same Pen-Drive it is possible to **export the screen** in **.BMP** format.

4.4 Power Supply and Battery charge

The internal supply is provided by a rechargeable battery pack (NiMh green), that allows an autonomy of continuous operation for at least 5 hours (8 hour typical).
When using the instrument without external supply, it is possible to check continuously the state of charge of the batteries, thanks to the icon shown  in the upper right side of the display; the number of the bars contained in the icon is proportional to the charge of the batteries.
An acoustic beep indicates the low batteries charge. To save the capacity of batteries an internal circuit will automatically switch off the instrument, after saving the last configuration and set-up.

The ACT6000 is fitted with a polarized socket "**SUPPLY**" for the connection to the AC Power Supply Adapter for battery charge.
When the right DC voltage is supplied to the above mentioned socket, the charging status is shown by the led on top panel:

Green led "**Ready**" or "*prompt to charge*" and yellow led "**Charge**" or "*batteries on charge",* at the final phase of charge, orange led "**T.O.C.**" or "*Top of Charge*". The lighting of the red led "**Fault**" means a temperature problem of the batteries or related charger circuit.

5 Technical Specifications

General

Case.....: ABS shielded for EMI / EMC compatibility.

Connections.....: • "RTX" connectors IN/OUT and “TX” OUT triple banana-jack;
• polarized connector for external supply;
• RJ-45/4 connector for headset;
• USB port for PC connector and RS232 to service *;
• USB for pen-drive connector.

Display .....: LCD color 320 x 240 pixel (1/4 VGA) backlit.

Power supply (internal).....: • rechargeable battery pack (green) NiMh, with life of about 8 hours (typical), 5 hours (minimum).
• external: from 16,5 to 26,5 Vdc / max 2,5 Ah.

Dimensions and Weight.....: 150 x 210 x 50 mm / 1,5 Kg. (batteries included).

Temperature range .....: Operating: 0 ÷ +45° C. / Storage -20 ÷ +70° C.

Humidity range.....: 5 ÷ 90% non-condensing.

Overvoltage Protection.....: In/Out RXT connectors up to 150 Vdc / 140 Vpp.

Reference Frequency accuracy : ±1 ppm within the operating temperature ±2 ppm/year.

Reference Level accuracy.....: ±0.025% within the operating temp. ±0.025% / year.

CE mark - EMC .....: Directive 2004/108/CE, 89/336/EEC, Decree 2007/194 CISPR 11, ISO 14253 and CEI EN: 61326/A1/A2, 55011, 61000-4-2, 61000-4-3, 61000-4-4, 61000-4-6, 61000-4-11.

Special Features and Setup.....: • Software update and Results Export on Pen Drive;
• Results storage on internal flash memory;
• PC Remote interface by USB port *.

Signal Generator

Sine output frequency range.....: • base band: from 20 Hz to 20 kHz;
• middle band: from 20 kHz to 6 MHz;
• high band (optional): from 0.02 to 30 MHz.

Frequency Resolution .....: 1 Hz up to 9.999999 MHz; 10 Hz over 10.0 MHz.

Frequency setup mode.....: manual on single frequency and step mode on programmable band / steps.

Output level .....: -60 ÷ +20 dBm @ 150 Ohm / 0.1 dB steps.

Output level accuracy.....: ±0.2 dB from 400 Hz to 20 kHz @ 600 Ω;
±0.2 dB up to 2 MHz, ±0.3 dB up to 6 MHz; @ 100 Ω;
±0.5 dB up to 10 MHz, ±1 dB up to 30 MHz @ 100 Ω.

Balanced output impedances....: • base band: 150, 200 and 600 Ω
• middle band: 100, 110, 120, 135, 150 and 1350 Ω.
• high band 100 Ω.

Unbalanced output impedances: 50 and 75 Ω by Banana/BNC optional adapter.

White Noise Generator .....: 1 kHz ÷ 6 MHz / -74 ÷ -144 dBm/Hz / 0.1 dB steps.

* *by Advanced Software 2*

Signal & Level Meter

Frequency range.....: from 20 Hz to 6 MHz (two bands) base version;
up to 30 MHz (with EBM 30 optional module).
Manual tuning / resolution……..: 1 Hz up to 9.999999 MHz; 10 Hz over 10.0 MHz.
Level measurement mode…… : absolute (dBm or dBV or Volt) or relative (dBr).
Input range……..…..: -120 ÷ +12 dBm @ 100 Ω / 0.1 dB Resolution.
Level meter accuracy……..…: ±0.2 dB from 400 Hz to 20 kHz @ 600 Ω;
±0.2 dB up to 2 MHz, ±0.3 dB up to 6 MHz; @ 100 Ω;
±0.5 dB up to 10 MHz, ±1 dB up to 30 MHz @ 100 Ω.
Noise floor (TX OFF)……...: ≤-140 dBm/Hz.
Frequency Meter sensitivity……: ≤ -50 dBm on wide band or selective mode.
Input impedances balanced.....: • base band: 150, 200, 600 and >10 kΩ;
• middle band: 100, 110, 120, 135, 150 Ω and >10 kΩ;
• high band 100 Ω and > 5 kΩ.
Input impedances unbalanced..: 50 and 75 Ω by Banana/BNC adapter.
Noise filters……..……: • **base band**: Psophometric; C-Message; 0.3 ÷ 3.4 kHz, 0.02 ÷ 3.4 kHz, 0.3 ÷ 6.0 kHz, 0.02 ÷ 6.0 kHz, 0.3÷15.0 kHz, 0.02÷15.0 kHz, 0.3÷20.0 kHz, 20 ÷ 20.0 kHz, 20.0 kHz flat,
• **middle/high band**: E, F, G and VDSL 1 - 2.
Selective filters / notch……: • **base band**: (200 Hz ÷ 20 kHz) pass band and notch for S/N+D (dB and %) test; Selectivity:
- 10 Hz @ fo <200 Hz; - 5% fo @ >200Hz fo <4 kHz;
- 200 Hz @ fo >4 kHz.
Selective for telegrap. chann.: 120, 240, 360, 480 Hz.
• **high band** (20 kHz ÷ 6 or 30 MHz) selective: 25, 100, 200, 400 Hz and 1.74, 3.1, 4.0, 8.0, 16.0 kHz.

Spectrum and Network Analyzer

Frequency range.....: • from 200 Hz to 6 MHz (two band) base version;
• up to 30 MHz (by optional module EBM 30).
Input impedances balanced.....: • base band: 150, 200, 600 and >10 kΩ;
• middle band: 100, 110, 120, 135, 150 Ω and >10 kΩ;
• high band 100 Ω and > 5 kΩ.
Input impedances unbalanced..: 50 and 75 Ω by Banana/BNC optional adapter.
- **Base band** .....: 200 ÷ 25000 Hz, by FFT analyzer (Kaiser window).
Span.....: 6250, 12500 and 25000 Hz.
Resolution horizontal.....: 250 pixel / 10 div. : 625, 1.250, 2.500 Hz / division;
Resolution vertical.....: 192 pixel / 8 div.: 1, 2, 3 ÷ 20 dB / division
Resolution (BW).....: 50, 100, 200 .. Hz (other resolutions are interpolated).
- **Middle band**.....: 1 kHz to 6 MHz, by Digital SSB quad. conversion.
Span.....: 30 ranges: from 10 to 8000 kHz, 10 per decade.
Resolution horizontal.....: 250 pixel / 10 div: 1, 2, 4, 8, 16.. ÷ 800 kHz / division
Resolution vertical.....: 92 pixel / 8 div.: 1 ÷ 20 dB / division.
Resolution (BW).....: 0.2, 0.5, 1, 2, 5, 8 kHz (other resolutions are Interpol.)

- **High band**, measure method .: 20 kHz to 30 MHz, by double conversion receiver in three bands: 0.02 ÷ 12, 0.02 ÷ 18, 0.02 ÷ 30 MHz.
  (optional module)
  Resolution horizontal.....: 250 pixel / 10 div: 1.2, 1.8 and 3 MHz / division

Level reading mode.....: absolute: dBm, dBm/Hz, dBV and dBr (relative).
Measurement mode.....: normal, peak (max, mean or min. value), 2 Wires +/- (for Return-Loss measurement), 2 Wires +/+ (for Longitudinal Balancement measurement) and 4 Wires.
Input range .....: from noise floor ÷ +12 dBm @ 100 Ω .
Noise floor .....: ≤-140 dBm/Hz.
Resolution marker (lev. / freq.)..: 0.1 dB / as selected resolution (BW).
Network Analyzer.....: by tracking generator sweep or single freq. in 2/4 wires mode (sweep only for Medium and High Band).

Mix measurements Generator/Meter and Network Analyzer

- **Cross-Talk (4 Wires)**
  Test mode..... .....: Near-End (Single-End) and Far-End (End-to-End) single frequency or scanner on limited band.
  Frequency range.....: 200 Hz ÷ 6 MHz (up to 30 MHz - EBM 30 opt. module)
  Measurement accuracy .....: up to 2 MHz: ±1 dB / between 0 ÷ -90 dB;
  up to 6 MHz: ±2 dB / between 0 ÷ -86 dB;
  up to 30 MHz: ±3 dB / between 0 ÷ -80 dB.
  Intrinsic crosstalk.....: <- 90 dB (with precise resistive load).

- **Return Loss (2 wires)**
  Test mode .....: single frequency or scanner on limited band.
  Frequency range.....: 200 Hz ÷ 6 MHz (up to 30 MHz - EBM 30 opt. module)
  Measurement accuracy .....: up to 2 MHz: ±1 dB / between 0 ÷ -50 dB;
  up to 6 MHz: ±2 dB / between 0 ÷ -46 dB;
  up to 30 MHz: ±3 dB / between 0 ÷ -40 dB.

- **Longitudinal Balance Loss (2 Wires + Gnd)**
  Test mode .....: single frequency or scanner on limited band.
  Frequency range.....: 200 Hz ÷ 6 MHz.
  Measurement accuracy .....: up to 2 MHz: ±1 dB / between 0 ÷ -60 dB;
  up to 6 MHz: ±2 dB / between 0 ÷ -56 dB;

- **Single-End Insertion Loss (included on the Single-End-Line-Testing) ***
  Measuring Mode / readout.....: by FDR technology on High-Band / Spectral readout.
  Operating limits.....: - minimum line length: 100 meters;
  - max. line length: 4.5 km on wires 0.4 mm.
  Graphic Extrapolation.....: 20 kHz ÷ 6 MHz or 30 MHz (optional).
  Accuracy.....: ±1 dB up to 2.2 MHz; ±2 dB up to 30 MHz.
  Operating Impedance.....: 120 Ω balanced line.

* *by Advanced Software 1*

Event Tests

• **Micro-Interruptions - O.62 (base band)** and on **medium band**

Threshold level.....: -3 ÷ -20 dB - 2 kHz Test Tone (default) or on programmable input frequency up to 6 MHz.
Monitoring time .....: 4 min. ÷ 24 ours.
Events indicators.....: 5 Counters (0.3ms ÷ >1min); Event/Time ; Secs with Events.
Readout.....: Tabular and Time Domain Histogram representation.
Measure facilities .....: 2 kHz reference tone output from TX connector for loopback tests.

• **Impulsive Noise O.71 (base band)** or **medium** or **high band**

- Threshold level .....: 0 ÷ -60 dBm.
- Base band BW filters.....: 200 ÷ 12,000 Hz Flat, 600 ÷ 3,000 Hz, 300 ÷ 500 Hz.
- Monitoring time .....: 4 min. ÷ 24 hours.
- Events indicators.....: 1 Event Counter; Event/Time Ratio; Secs with Events.
- Readout.....: Tabular and Time Domain Histogram representation.

Special Measurements

• **Line Immunity by White Noise injection**

- Output level range.....: -70 ÷ -144 dBm/Hz @ Zref 100 Ω - 0.1 dB Resolution.
- Output impedance.....: 100, 120, 135, 150 and 1350 Ω (balanced).
- Bandwidth.....: 1 kHz ÷ 6 MHz.

• **TDR Fault locator**

Distance ranges……...: 90, 180, 450, 900, 1800, 3600, 7200 m. @ 0.600 PVF.
Zoom……..: vertical: -8 ÷ +77 dB; horizontal : 1x, 2x, 4x.
Distance resolution (by marker) : - minimum range: about 0.4 meters (or 1 foot);
- maximum range: about 40 meters (or 100 feet).
Operative mode……: single line (2 wires), Crosstalk (4 Wire), Differential by relative comparison with other line; Monitoring to events localization by Peak mode (Sample & Hold).
Pulse output level……..…… : short and long: 2.2 Vpp; Boost: 5.5 Vpp.
Pulse length…… : automatic on range selection, from 10 to 5000 ns.;
IN/OUT impedance…..……: 100, 110, 120, 135, 150 Ω (balanced)
TGC (automatic gain control).. : 0 ÷ 6 dB/km.
Propagation velocity…….. : PVF: 0,300 to 0,999 or PV (90 to 300 m/µs)

• **Digital Multimeter DC / AC** (by DMM optional module)

Measuring mode .....: between a-b; a-c (Gnd); b-c (Gnd) and reverse.
DC Voltage, Range / Accuracy .: 0 ÷ 140 Vdc / ≤2% of reading ±1 digit.
AC Voltage, Range / Accuracy..: 0 ÷ 100 Vrms / ≤2% of reading ±1 digit / 15÷3300 Hz

DC Resistance / Insulation
- Test Voltage .....: ≤ 100 Vdc (with current limit 1mA max).
- Range / Accuracy.....: 2 Ω ÷ 1 GΩ / ≤2% of reading ± digit;

LINE LENGTH BY LOOP RESISTANCE
- Line length evaluation .....: (as function of measured resistance)
- Line Gauges setting .....: from 0.4 to 0.9 mm or from AWG 26 to AWG 19.
- Line Resistance correction .....: from 1.01 to 1.60 x standard copper resistance.
- Line Temperature setting.....: set from -20° ÷ +60° C.
- Range / Resolution.....: 0 to 99.999 kUnits (meters or feet) / 1 units.
- Accuracy.....: as derived from measured resistance.

R-bal measurement / accuracy .: shorting a-b-c (gnd) / with > 5 Ω unbalancement.

RFL (Resistance Fault Locator)
- Loop resistance.....: 5 kΩ maximum.
- Fault resistance.....: from 100 Ω to 20 MΩ max.
- Accuracy of RTF @ 1 MΩ.....: ±0.5% of Loop resistance.

DC CAPACITANCE (time of DC discharge method)
- Test Voltage .....: ≤ 100 Vdc
- Range / Accuracy.....: > 10 nF ÷ 10 μF / ≤ 5% of reading ± 1 digit.

AC CAPACITANCE and Q factor (by capacitive bridge)
Measuring mode .....: by 1 kHz tone – 1.1 Vpp between: a-b;.
Range / Resolution.....: 0.1 to 3000 nF / 0.1 nF.
Accuracy.....: ±1% of reading ± 1 nF @ C <500 nF;
±5% of reading ± 1 digit @ C >500 nF and < 3000 nF.

LINE LENGTH BY CAPACITANCE
Line length estimation .....: (as function of measured capacitance):
Line Capacitance setup.....: 10.0 to 300.0 pF / Length Unit.
Range / Resolution / Accuracy..: 1 to 99999 Units (m. or ft.) / 1 units / as derived from measured capacitance.

• **POTS Subscriber Simulator** (by optional module installed on DMM module)
Dial Encoder .....: -Pulse, progr. duration/ratio (100 ms / 40/60%);
-DTMF std. tones, progr. Level, Duration, Inter-tone.
Ring Detect. Range & Meas .....: Level: 10 ÷ 90 Vrms; Frequency: 15 ÷ 70 Hz.
Ring Detector AC Load.....: R 7310 Ω ± 2% in series + 940nF ±10% capacitor.
Ring current self limitation .....: ≤ 15 mA peak ; safety fold-back limited.
On Hook / Break & Make specs.: R = 120 Ω ±2% @ I = 100 mA; Voffset = 4 Vdc.

* *by Advanced Software 2*

Automatic SELTest for line pre-qualification *
With **single ACT6000** - **Single-End Tests on open lines,** 2 or [4] Wire mode:
Metallics: AC / DC Voltage, DC Insulation, AC / DC Capacitance, End-Of-Line (TDR).
Transmissives (Wide band): Noise (local), Return-Loss, Longitudinal Balance-Loss, "FDR" Insertion-loss & frequency response estimation, Noise (far-end estimation), SNR prediction, ADSL - ADSL2+ and VDSL2 *** Bit-Rate prediction, [NEXT].

Automatic DELTest for line qualification **
With **two ACT6000** (Master/Slave configuration) for **Double-End Tests,** 2 or [4] Wire mode:
Only Transmissives (base and wide band): Noise (bilateral), Return-Loss (bilateral), Longitudinal Balance-Loss (bilateral "LCTL"), Insertion-Loss, SNR (bilateral), ADSL - ADSL2+ and VDSL*** Bit-Rate evaluation (Up & Down stream), [NEXT and FEXT].

Masks for pre-configured SELT or DELT line tests *
- Wide band: **ISDN, HDSL 1p** and **2p, E1, T1, SHDSL, ADSL, ADSL2+**, and **VDSL2-12a, VDSL2-17a, VDSL2-30a *****.

Masks for pre-configured DELT telephone tests **
- Base band: **M1040, M1020, G.712E2, EURO16k, EURO32k, MIL16k, MIL32k**

Notes:
** by Advanced Software 1*
*** by Advanced Software 2*
**** by adoption of EBM 30 optional module*

Supplied Accessories (base kit):
ACT6000 Base Instrument, included:
- Nylon Carrying Case with pocket for accessories;
- User Guide (English or Italian language, as requested);
- AC Power Supply and Battery Charger (Line Input: 100-220 Vac; Output: 20 Vdc);
- Banana-Banana + Crocodiles shielded cable (2.30m total length);
- Ground Cable unipolar Banana-Crocodile cable;

Extra cost Accessories and Optional HW/SW Modules
- **ASW1 - Advanced Software 1** (see the above description).
- **ASW2** - **Advanced Software 2** *(to be develop)*, it will include the End-to-End (Master/Slave) function with a couple of ACT6000 and PC utility programs for Remote Control by USB port, Direct SW Update, Direct Capture Screen - Export & Read Saved Measurements, Masks Editor.
- **ACT-11** POTS Module (Subscriber Simulator Module for POTS for signalling tests);
- **ACT-12** DMM Module (Digital Multimeter Module for metallic tests);
- **ACT-13** EBM30 Module (Extension Band Module for 30 MHz operation);
- **ACT-14** USB Pen-Drive 4 GB;
- **ACT-15** Probes to perform Medium & High Band PSD measurement on lines fed;
- **ALT-05** Headset with 2m cable and RJ-45/4 connector;
- **ALT-09** Resistive Termination Set (100, 120, 150 and 600 Ω);
- **ALT-16** Banana to BNC Adapter.

6 Commands and Connections description

6.1 Front panel Commands description

1-  (Power) Key for switching On/Off.
A short press of this key switches ON the instrument, while a long press switches Off.

2-  (Hold) Key for the temporary freezing of the measurement. This command allows access to a “Save” function to store and/or export the file measurement.

3-  (Talk) Key for enabling the intercom circuit; this command enables only the microphone, in as the headphone is always enabled. This command switch the Line Hook-Off / Hook-On when activated the POTS Subscriber Simulator.

4-  Commands group ◄ ►▲▼ plus selection function (as “Enter”), for menu selection and parameters setting.

5- Keys group for the setting of alpha-numerical parameters.

6- (Clear) Key for cancellation, it enables also the export the screen shot In BMT format to the USB Pen-Drive.

7- (Enter) Key for selection / confirmation.

8- (Escape) Key for exit and return to previous state.

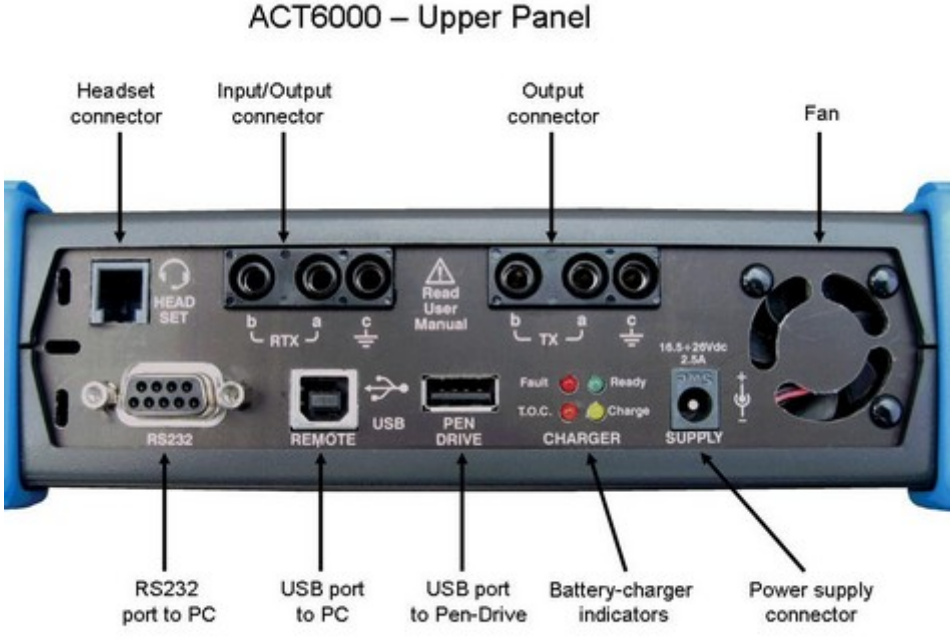
9- Function keys group (the associated function is highlighted in the relevant area of the display).

10- Multifunctional key for temporary adjustment of the brightness / contrast of the display and for the switching On/Off of the internal loudspeaker.

11- Key for software release and instrument information.

BATT. Rubber corner protection of the battery compartment .

6.2 Upper panel Connections Description

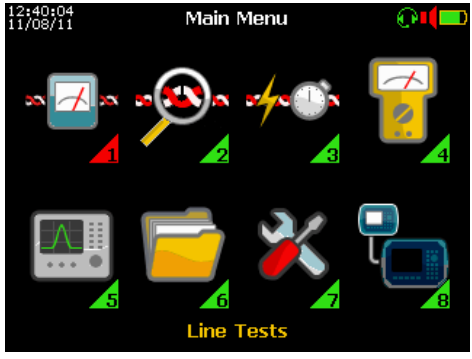


7 Use mode (frequent commands, menu hierarchy ..)

Frequent Commands

The ACT6000's human interface is very intuitive due to the displayed info.
The function keys (***F1*** - ***F5***), allows various configurations or facilities related to the specific menu.

At switch On the Main Menu is displayed where the various types of selectable measurements or functions and other configuration menus are shown.
On the Main Menu the date & time are shown battery status, loudspeaker /headset enable.



The selection of any item is made by the use of the arrows ▲▼ of the commands group or by pressing the associated number on the keypad.

In most of the active menus it is possible to adjust the LCD brightness / contrast and volume loudspeaker through the key and the ▲▼of the commands group.

When a menu is selected, by the commands group, to access the next menu it is necessary to confirm the choice with the (Enter) key;
if the selection takes place by the keypad, the entry to the next menu is straight forward.

Return to a previous menu is always allowed by the (Escape) key.

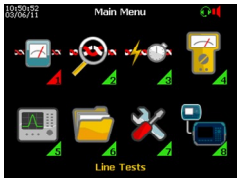
By pushing the "Photo" key, the measurement can be temporary frozen and a special function-key will be enabled to save the measurement on the internal memory. By pushing the key the measurement will be reactivated.

Where possible, pushing the (Cancel) key allows the immediate upload the screenshot to the Pen-Drive (image in BMP format).

Note:
Depending on the software release or the unavailability of some functions or internal optional modules the related selection may not be available

Menu Hierarchy

Main Menu
From this main menu, by selecting the icon-number with the ◄ ►▼▲ arrows and confirming with "Enter" it is possible to access the available functions. Quick access is possible by typing on the keypad the number of the icon.



1- Line Tests Access the sub-menu for automatic and pre-configured copper pairs qualification in SELT or DELT mode and POTS services.

2 - TDR Fault locator Access the TDR sub-menu to find the End-of-Line and possible faults on copper pairs.

3 – Event tests Access the sub-menu to monitor events such as microinterruptions or impulsive noise on copper pairs and other lines types.

4 – Multimeter Access the sub-menu for metallic measurements such as voltage, resistance, insulation, capacitance of copper pairs and other devices.

5 – Signal Analyzer Access the sub-menu for signal generation, selective measurements, spectral or network analysis on copper pairs or other lines or devices.

6 – File Manager Access the sub-menu for management and export of filed measurements.

7 – Config. & Utility Access the sub-menu for the initial setup of the instrument (date/hour, display.. and measurement parameters).

8 – Slave mode
Special configuration to set the instrument as Slave to perform some automatic and pre-configured End-to-End tests on copper pairs and lines.

7.1 Events Tests

This item allows the selection of some test functions oriented to line troubleshooting such as MICROINTERRUPTIONS and IMPULSIVE NOISE .

7.1.1 Micro-interruptions Test

This test can be performed in three ways: **End-to-End**, **Single-End** and **Tracking**.
For the **End-to-End** mode it is necessary to use two instruments (one as Generator and one ACT6000 as Meter, connected at opposite ends of the line under test.
For the **Single-End** mode a single ACT6000 is used, but it is necessary to have available a good reference line to transport the reference signal up to the end of the line under test by a simple loop.
For the **Tracking** mode a single ACT6000 is used together with the constant presence on line of a good reference signal between 1 kHz and 6 MHz, with suitable stability (under ±10 ppm) and suitable level (> -20 dBm and < +10 dBm).

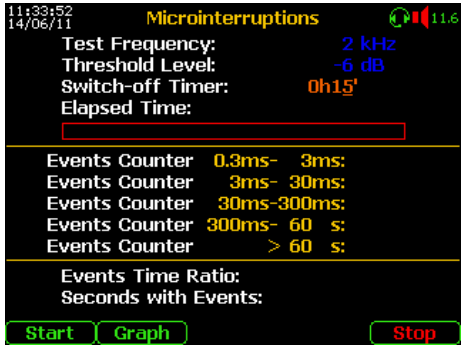
Single-End mode
After the creation of the loop between the lines, connect the reference line (good) to the TX connector of the ACT6000 setting the Test Frequency to 2 kHz.

End-to-End mode
Set the Remote Generator (*it can be another ACT6000*) to **2 kHz** / **600 Ohm** / **0 dBm** (*for the ACT6000 see the Generator & Meter instructions on this guide*) and connect the line under test to the output of this generator.

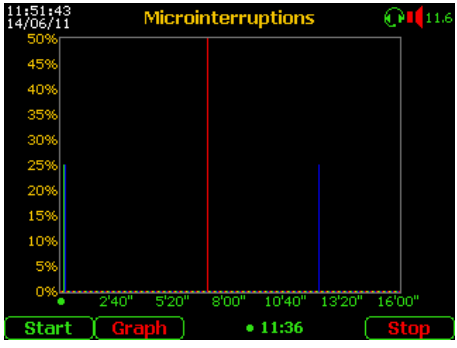
Tracking mode
Set on the ACT6000 the same Test Frequency of the reference signal already present on the line.

Measurement setup
From the **Main Menu** select and enter on the **1 Event Tests,** then select the "**2. Microinterruption**" function; the display will show the following menu.

- Connect the line under test to **a** – **b** points of the **RTX** connector, if the Test Signal is in the voice band a tone will be heard on the internal loudspeaker (if needed it is possible to reduce the volume by pressing the command and the▼ arrow).
- By pushing the key set the Threshold Level, below which is defined the signal interruption;
- By , "**Enter**" and ▲▼ arrows set the Switch-off Timer (≥ 15 min. is suggested);
- Push the "**Start**" (**F1**) key.



At the end of the test, all the results will be shown on the display.



During the test, or at the end, pushing the ***F2*** "**Graph**" key will show the graphic representation in the time domain on the horizontal axis.
The percentage of seconds with events will be represented on the vertical axis.
Re-pushing the ***F2*** key goes back to the tabular representation.

By pushing the "Photo" key, the measurement can be frozen and the ***F5*** key will allow to save the measurement to be saved in the internal memory.

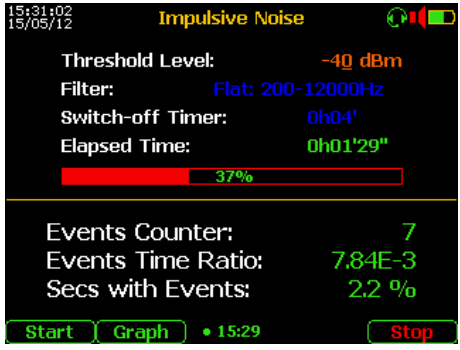
7.1.2 Impulsive Noise Test

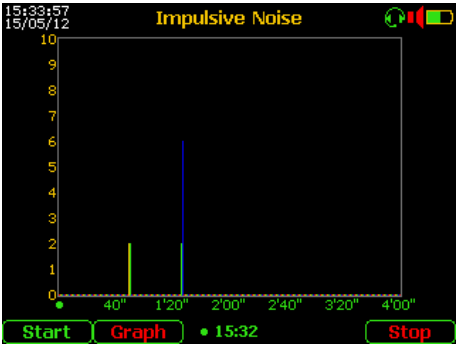
Measurement setup

From the **Main Menu** select and enter on **3 Event Tests,** then select the "**1. IMPULSIVE NOISE**" function; the display will show the following menu.

- Connect the line under test to the **a** – **b** points of the **RTX** connector;
- By pushing the ↻ key set the Threshold Level to noise detection;
- By ↻, "**Enter**" and ▲▼ arrows set the Band Filter and the Switch-off Timer (≥15 minutes is suggested);
- Push the "**Start**" (**F1**) key.

At the end of the test, all the results will be shown on the display.





During the test, or at the end, pushing the ***F2*** "**Graph**" key will show the histogram representation in the time domain on the horizontal axis.
The number events will be represented on the vertical axis.
Re-pushing the ***F2*** key goes back to the tabular representation.

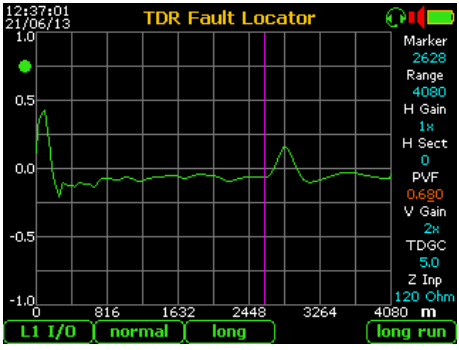
By pushing the 📷 "Photo" key, the measurement can be frozen and the ***F5*** key will allow to save the measurement to be saved in the internal memory.

7.2 TDR Fault Locator

This item allows the selection of a useful function to locate a fault along the line or to estimate its total length. Any impedance mismatches on the line under test are shown as upward pulses when the impedance increases (up to the "open circuit"), and downward pulses when the impedance decreases (up to the "short circuit").

Measurement setup

From the **Main Menu** select and enter on the function **TDR Fault locator,** the display will show the following menu.



- Connect the line under test to the **a** – **b** point of the **RTX** connector and observe the graph.
- If in the selected range a positive trace is displayed (as shown on the image at left) or negative (if the line was in short circuit), select the "Marker" window by ↻ key and ▲▼ arrows, then using the ◀ ▶ arrows move the marker bar on "knee" of last upward pulse; the distance is shown in the marker window.

If necessary, optimize by using the "**Range**" / "**H Gain**" / "**H Sect**" commands the horizontal display of the trace in the centre / right of the grid.
If necessary modify the "**V Gain**" parameter to optimize vertical display of the envelope, and/or the "**TDGC**" parameter to increase or decrease the gain of the receiver.

The selection of the parameter related to the Pulse Velocity Factor (**PVF**, **Ft/µs**, **V1/2** etc.) and to the Distance Measure Unit (**Meters** or **Feet**) it must be performed into the "**7. Config. & Utility**" menu.
To the automatic set of the **PVF** it is suggested to select the preponderant cable type from the "**8. Cable Setup**" menu of the **Config. & Utility**" group (see at page 34).

long run

To clean the trace related to a long line (over 3km) and very noisy, it is suggested to press the ***F5*** "**long run**" key. A repetition of 64 tests (in about 20 seconds) will be able to clean the trace of the possible "end-of-line" echo.

Other setting:

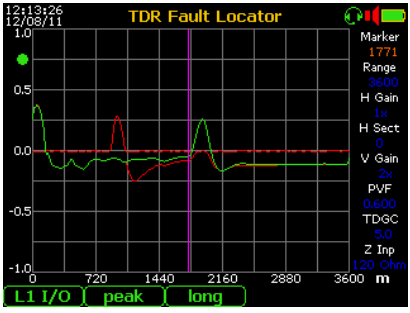
L1 I/O
L1 I/L2 O

By repeated pushing of the ***F1*** key and [↵] "Enter" the IN/OUT of the TDR front-end can be changed; the "**L1 I/O**" is the usual mode operation to localize faults or anomalies on the line under test connected to RTX connector. The "**L1 I/L2 O**" is an useful operation mode to find and localize the possible cross-talk point between two lines connected to TX and RTX connector.

normal
relative
peak

By repeated pushing of the ***F2*** key and [↵] "Enter" the TDR operating mode can be changed from "**Normal**" to "**Relative**" (to zero the echogram and highlight only the new mismatching) or "**Peak**" to sample and hold intermittent discontinuities during long term measurements.
The "**Relative**" mode is useful to detect mismatching among two lines on the same cable.

On this image is shown an echo-graph at the end of the monitoring time on "**peak**" mode.



The TDR has captured a short positive trace from a line interrupted for a short time.
This function is very useful to find and localize any intermittent events on the line (short circuit, false contacts or open circuit).
If necessary to measure the **differential distance** between two envelopes, pushing the ▲ or ▼ arrows into the Marker window, it is possible to enable a second Marker and move it by the ◀ ▶ arrows on the needed point.
To clear the second Marker it is sufficient push the ▲ or ▼ arrows into the Marker window.

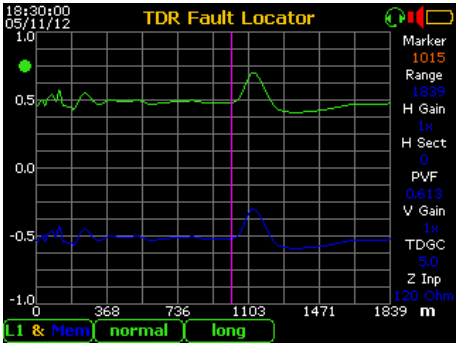
By repeated pushing of the ***F3*** key and [↵] "Enter" the "**long**" pulse generally used for medium/long ranges (over 500 meters) can be selected.
Selection of the "**short**" pulse is suggested for short ranges (under 500 meters).
In the cases of noisy or very long lines (over 4 km) it is possible to set the "Boost" pulse. It is always recommended to limit the time this mode with a strong pulse is used to avoid possible interference with adjacent lines.

By pushing the [📷] "Photo" key, the measurement can be temporarily frozen and the ***F5*** key will be enabled to save the measurement in the internal memory.
By pushing the [↩] key the measurement will be reactivated.

By pushing the [✕] key the image on the display will export in BMP format on the USB Pen-Drive.

COMPARATIVE TEST

If desired to compare the real-time echogram with another one previously performed and memorized, follow these instructions:



- From **Main Menu** enter with "**8. File Manager**" menu and select the test to be compare, then push ***F5*** key.

- Return on the **Main Menu** and enter with "**2 TDR Fault Locator**" menu, by the ***F1*** key select the [L1 & Mem] mode.

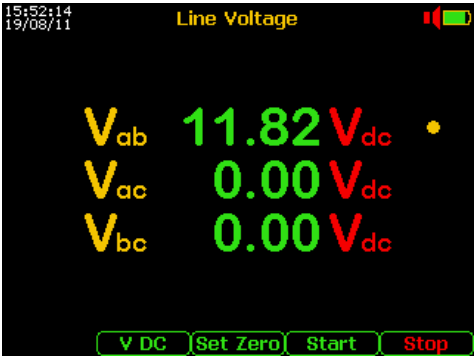
  As on the image at the left, will be shown the real-time graph (top side and green) and the old graph (bottom side and blue).

Selecting by the ***F1*** key the [L1 - Mem] modality, will be shown the differential graph between the two echograms.

7.3 Digital Multimeter

(by DMM optional module adoption)
This item allows the selection of some metallic measurements:
AC/DC Voltage, to measure extraneous voltage on the line, **AC/DC Capacitance** to measure the **AC** capacitance and **Q** of the line or **DC** (by capacitor discharge method) the capacitance value of the line plus the possible capacitance loads (i.e. telephones), **Resistance** to measure the loop resistance, **R-Bal** to measure the wires balancement, **Insulation** to measure the insulation resistance between the conductors and Gnd and the **RFL** to localize the possible low insulation points of the line.
The occasional calibration of the DMM is allowed by pushing the ***F1*** "**DMM Cal**" key.

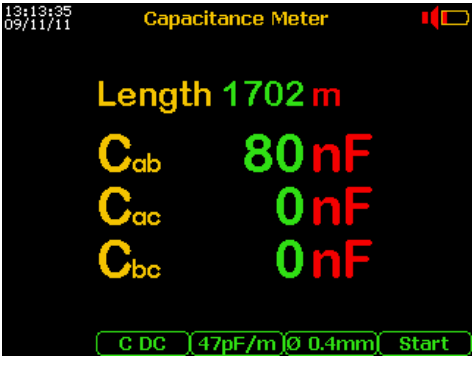
7.3.1 DC/AC Voltage Measurement



From the **Main Menu** select and enter the **Digital Multimeter** function, then select item **1. Line Voltage**; on the display will appear the menu shown to left.
- Push "**Set Zero**" before connecting the test cables .
- Push the ***F2*** key to select the measurement mode **V DC** or **V AC**.
- Connect the line to **a** – **b** points and GND ref. to the **c** point of the **RTX** conn.
- Push the ***F5*** "**Start**" key and wait for the sequence of results to be displayed.

● **Vab** value still in real-time

7.3.2 DC/AC Capacitance Measurement



From the **Main Menu** select and enter the **Digital Multimeter** function, select item **2. Capacitance Meter**; then select by ***F2*** key the test modality AC or DC.
- Connect the line to **a** – **b** points and GND ref. to the **c** point of the **RTX** conn.
- Disconnect the AC/DC battery charger.
- Push the ***F5*** "**Start**" key to show the results progressively .

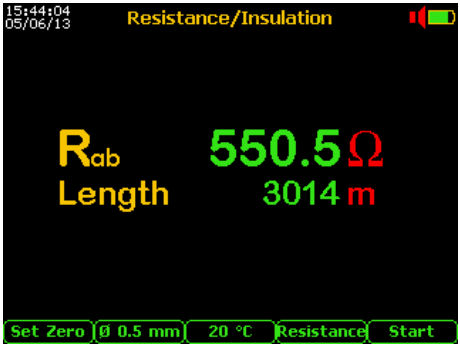
When the capacitance value between **a**-**b** is congruent with the typical capacitance of copper lines, an estimation of the length related to the capacitance value per meter is automatically shown (see the **Cable Setup** menu at page 34).
By repeated pushing of the ***F3*** key and then [↵] "Enter" it is possible to set the capacitance value per meter of the line under test.
By pushing the [📷] "Photo" key, the measurement can be temporarily frozen.

By pushing the [✕] key the image on the display will export in BMP format on the USB Pen-Drive.

7.3.3 Resistance Measurement (Loop and/or Insulation)

Loop Resistance

From the **Main Menu** select and enter the **Digital Multimeter** function, select item **3. Resistance/Insulation**, then press "**Enter**".

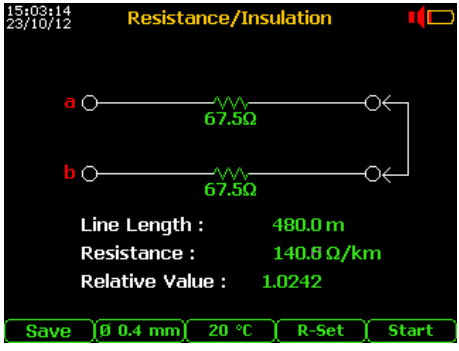


By the **Cable Setup** menu (see page 34) select the presumed cable under test.
Short the line (**a** – **b**) at the opposite side.
Connect the line to **a** – **b** points of the RTX.
If necessary correct the presumed cable gauges by ***F2*** key.
By ***F3*** set the presumed temperature of the cable then press ***F5*** "**Start**".
When the loop resistance between **a**-**b** is congruent with typical resistance value of copper line (under 5 kOhm), an estimation of the length related to the loop resistance value per meter is automatically shown.

To improve the loop resistance test accuracy, short the end of the cable-test (**a** – **b** points) and press **F1** "**Set Zero**".

Setup of the true copper resistance

Knowing the exact length or exact resistive value of a line, by a special procedure it is possible adjust the copper resistance to increase the lines length accuracy.



Select by ***F4*** key "**R-Set**" then press ***F5*** "**Start**";
By ◄►▲▼ set the right **Line Length** or by ↻ command and ◄ ► ▲ ▼ the right "**Resistance**",
Push ***F5*** "**Start**".
As suggested on the display, short the end of this line then press ***F5*** "**Start**".
Remove the short circuit and push again ***F5***.
With the certainty of the right "Relative Value", press again ***F5*** "**Start**" and then ***F1*** "**Save**".

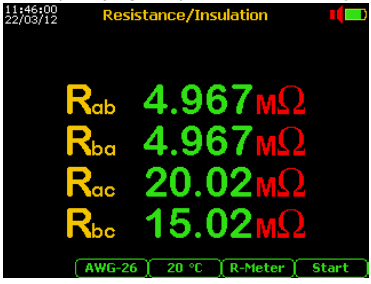
From this moment all the tests related to the resistance measurement will be always calibrated with this resistivity value.

To restore the default (factory) standard copper resistance from the **Main Menu** select "**7. Config & Utility**" and push ***F1*** "Default".

Insulation Test **ATTENTION! For this test disconnect the external power supply!**

From the **Main Menu** select and enter the **Digital Multimeter** function, select item **3. Resistance/Insulation**. By ***F4*** select the "**Insulation**" test and push "Enter".
Warning! During the test cycles don't manage the line (a-b) or "ground" (c) connections.

*Note: to the good length estimation it is opportune to select the cable type from the **Cable Setup** menu (see page 34) and, if necessary, setting the right conductor resistivity (see page 22),*

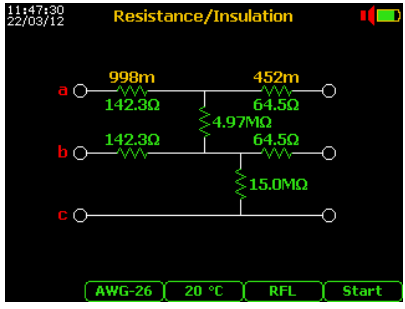


- Connect the line to **a** – **b** points of the RTX connector and the Gnd ref. to "**c**" point.
- By ***F2*** select the presumed wires gauge, if different from the cable selected by the **Cable Setup** menu.
- By ***F3*** set the presumed temperature of the cable then press ***F5*** "**Start**".

If the result of insulation value between "**a**", "**b**" or "**c**" wires is under 20 MOhm, it is possible to estimate the distance to the fault by the RFL function.

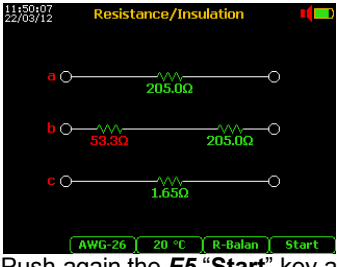
7.3.4 Low Insulation Localization (RFL)

*First of all it is necessary to find the "**a**" or "**b**" conductor at the end of the line. A possible method is to perform a short circuit between one conductor of the line and the reference conductor (of other line or "earth" / "Gnd" reference point of the street cabinet, box or the shielding of the cable). Performing again the resistance measurement by pushing the **F5** "**Start**" it is possible to find what conductor ("**a**" or "**b**") has been used for this test.*
*Remove the short-circuits and repeat the **Insulation Test** above described.*



Push more time ***F4*** to select "**RFL**" mode, then push "**Enter**".
On the display will appear the advises that invites the remote technician to short some conductors. Performed the first short it is necessary to push again the ***F5*** key and wait the possible next step. Follow the instructions shown on the display for the final calculation.

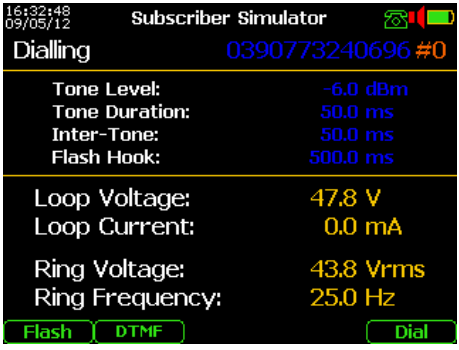
7.3.5 Resistive Balancement "R-bal" measurement



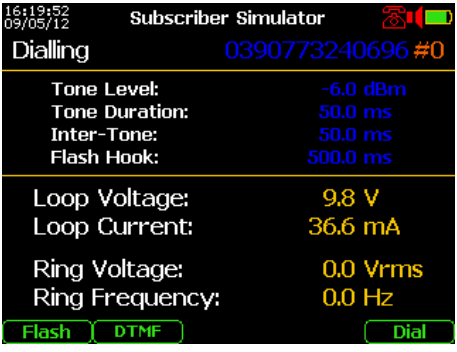
From the **Main Menu** select and enter the **Digital Multimeter** function, select item "**3. Res. / Insulation**" By the ***F4*** select the **R Balan**" function, then press **"Enter"**. Connect the wires of the line under test and the reference wire (or "Gnd" reference) to the "**a**" "**b**" and "**c**" points respectively of the **RTX** connector. Pushing the ***F5*** "**Start**" will appear the advise that invites the remote technician to short the three conductors at the other side of the line.
Push again the ***F5*** "**Start**" key and wait the end of the test. If the resistance value of the "**a**" it is different over **5 Ohm** respect to the "**b**" wire, will be shown on graph the additional (differential) resistor and its resistance value (in red) as the figure above.

7.4 Subscriber Simulator

By the adoption of the POTS-SUB optional module (installed on the DMM module) it is possible to perform a simple test to verify the CO signalling parameters using the ACT6000 as POTS telephone device.
From the **Main Menu** select and enter on the "**1. Line Tests**" menu, then select and enter on the "**3. SUBSCRIBER SIMULATOR**".



Connecting the telephone line from the CO to the **a** – **b** points of the **RTX** connector, it is possible to verify immediately the Loop Voltage (CO line feed) in Hook-On condition.
On this condition it is possible to measure the possible Ring Voltage and Frequency.
For answer:
Next the Ring tone detection engage the line pushing the key.
On this condition it is possible the conversation with the caller using the Headset connected to the instrument.
When the test is finished disengagement the line pushing the key.



For call-up:
- Select the "**Dialling**" line pushing the key and press "Enter".
- Type the Line Service telephone number and then press "Enter".
- Push the key to engage (Hook Off) the telephone line.

On this condition is shown the Loop Voltage and Current.
- Start the call-up pushing the ***F4*** "**DIAL**" function key.

During the line engagement it is allows the conversation with the responder using the Headset connected to the instrument.
When the test is finished disengagement the line pushing the key.

Other settings:

By pushing the ***F2*** function key it is possible to select the DIAL mode: standard **DTMF** tones or standard **Pulse**.

Selecting the Tone parameters by and the ▲▼ arrows it is possible to change the Tone Level, Duration, Inter-Tone, but also the Flash Hook duration.

Pushing the "**Flash**" ***F1*** function key it is possible to temporary disengagement and re-engagement the line.

7.5 Signal Analyzer

This item allows the selection of some measurement functions to test the transmission performance of lines, apparatus and communication systems.

GENERATOR & METER:
Sinusoidal Signal Generator, wide or weighed band and Selective Level Meter up to 20 kHz, Selective Level Meter for medium/high band up to 6 MHz (or 30 MHz by internal optional module), selective or wide band Frequency-Meter.
It allows these measurements to be performed:

- **Insertion Loss** (at a single frequency with two instruments);
- **Noise** (wide and weighed on base band);
- **Crosstalk** (near);
- **S/N** and **Distortion** (in the base band);
- **Signal Frequency**.

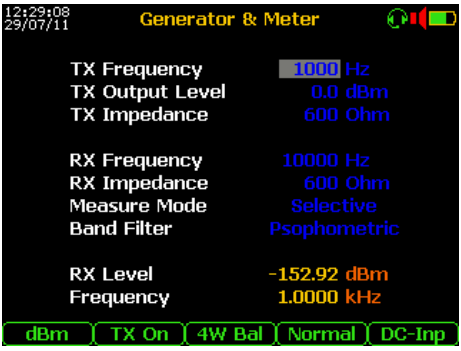
SPECTURM & NETWORK ANALYZER:
This is a powerful analyzer to measure **signals** and/or **noise** levels with various input configurations such as: low and high impedances or DC decoupling to perform special “sniffer” measurements on powered lines.

In 4 Wire mode, using the tracking generator output (TX) separate from the receiver input (RTX) it is possible to perform these spectral measurements:
- **Insertion Loss** of loop lines or channels or various quadrupole devices;
- **Crosstalk** (NEXT) between two lines or channels.

In 2 Wire mode, using the active bridge and the tracking generator (RTX connector), it allows:
- **Return Loss** measurement;
- **Longitudinal Balance Loss** measurement.

7.5.1 Generator & Meter

From the **Main Menu** select and enter the **Signal Analysis** item, then select and enter one of these bands: **1. BASE BAND TESTS** or **2. MEDIUM BAND TESTS**.
Select the item **1 GENERATOR & METER**, on the display will appear this menu:



By pushing key and ▲▼ arrows select the required TX and / or RX parameter, confirming the selection by the key, then modify the parameter by ▲▼ arrows.
For the RX section (only for base band), it is possible to select the **Measurement Mode**: wide band, selective, notch and S/(N+D) for distortion measurements and narrow bands:120, 240, 360, 400 and 480 Hz BW.
By using the **Band Filter** it is possible to select various weighting bands.

When the Medium/High Band Test is selected the RX works only in selective mode.
There are the selectable filters: 25, 100, 200, 400, 1740, 3100, 4000, 8000 and 16 kHz.

Other settings:

dBm
dBm/Hz
dBV
Volt

By repeated pushing of the ***F1*** key and then "Enter" key, the following level reading mode **dBm**, **dBm/Hz**, **dBV** and **Volt**. can be selected

TX On
TX->RX
TX Off

By repeated pushing of the ***F2*** key and then "Enter" key, it is possible to set the generator: **TX On** (on any programmable frequency), **TX->RX** (RX and TX on same frequency), **TX Off** (to switch-off the generator, a very useful thing to measure very low level signals.

4W Bal
4W Unb

By repeated pushing of the ***F3*** key and then "Enter", it is possible to set the front-end of the instrument to: **4 W**ires (separated TX and RX) on **Balanced mode** for copper pairs tests or **4 W**ires (separated TX and RX) on **Unbalanced** mode for coaxial cables tests.

Normal
MaxVal
MeanVal
MinVal

By repeated pushing of the ***F4*** key and then "Enter", it is possible to select the measurement mode: **Normal** or highlighting in red text the **Maximum** or **Mean** or **Minimum** input level.

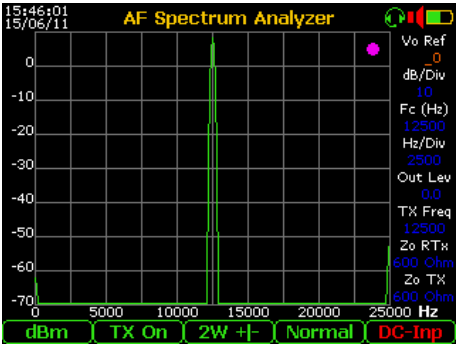
DC-Inp
AC-Inp

By repeated pushing of the ***F5*** key and then "Enter", it is possible to configure the front-end of the instrument to perform the measurements by AC or DC coupling useful to increase the level accuracy of low frequency.

To measure the **frequency** of the input signal it is necessary to push the */· Key.
The sensitivity threshold of the frequency-meter is about -30 dBm.

7.5.2 **Spectrum & Network Analyzer** (for Base and Medium Band)

From the **Main Menu** select and enter the **Signal Analysis** item, then select and enter one of these bands: **1. BASE BAND TESTS** or **2. MEDIUM BAND TESTS** and select the item **2. SPECTRUM ANALYZER**, will appear this menu:



By pushing the ↻ key and ▲▼ arrows select the RX and / or the TX parameters: **Vo Ref** (to set the grid range), **dB/Div** (to set the vertical resolution), **Fc (Hz)** (to set the central frequency on the grid), **Hz/Div** (to set the horizontal resolution), **Out Lev** (to set the output level of the generator), **TX Freq** (to set in Hz the fixed frequency of the generator), **Zo RTx** (to set the Input or In/Out impedance), **Zo TX** (to set the Output impedance). After the selection, pushing the ↻ it is possible to modify the parameter by using the ▲▼ arrows.

Other setting:

dBm
dBm/Hz
dBr
dBV

Repeated pushing of the ***F1*** key and [⏎] "Enter" the following level reading mode: **dBm**, **dBm/Hz**, **dBr** and **dBV** can be selected.

TX On
Noise
TX SW
TX Off

By repeated pushing of the ***F2*** key and [⏎] "Enter" it is possible to set the generator: **TX On** (at a fixed programmable frequency), **Noise** (wide band white noise), **TX SW** (sweep signal tracking with RX, **TX Off** to switch off the generator, an useful thing to measure low signals (e.g. noise level).

2W +:-
2W +:+
2W Unb
4W Bal
4W Unb

By repeated pushing of the ***F2*** key and [⏎] "Enter" it is possible to set the measurement mode: **2 W +:-** (2 wires Balanced) - mix TX/RX to measure the **Return Loss**, or **2W +:+** (2 wires Balanced) - mix TX/RX to measure the **Longitudinal Balance Loss**, or **4W Bal** (4 wires Balanced), or **4W Unb** (4 wires Unbalanced) to measure the Cross-Talk "Next" or the Insertion Loss of a loop line).

Normal
MaxVal
MeanVal
MinVal

By repeated pushing of the ***F4*** key and [⏎] "Enter" it is possible select the measurement mode: **Normal** or highlighting in red text the **Maximum** or **Mean** or **Minimum** input level.

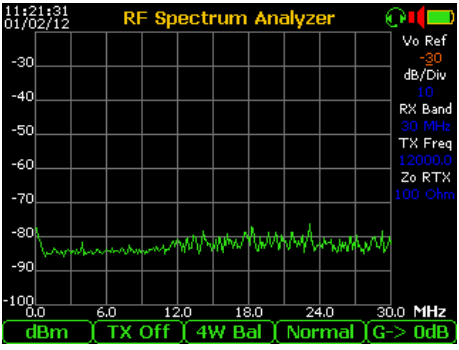
DC-Inp
AC-Inp
Probe

By repeated pushing of the ***F5*** key and [⏎] "Enter" it is possible to configure the front-end of the instrument to perform the measurements by **DC** or **AC** coupling or by external HighZ **Probe** to perform the PSD on powered lines.

By pushing the [📷] key it is possible to freeze the measurement and, by moving the marker using the ◄ ► arrows, to read the amplitude and frequency of any point of the trace on the first two windows at the top right of the display.
By using the same key is enabled the "**Save**" function to save the measurement on internal memory; by the [✕] key is allowed the export on the USB Pen-Drive the image on the display (in BMP format).

7.5.3 **Spectrum & Network Analyzer** (for High Band)

From the **Main Menu** select and enter the **Signal Analysis** item, then select and enter on **3. HIGH BAND TESTS** and select **2. SPECTRUM ANALYZER**, will appear this menu:



By pushing the ↻ key and ▲▼ arrows select the RX and / or the TX parameters: **Vo Ref** (to set the grid range), **dB/Div** (to set the vertical resolution), **RX Band** (to select **0 to 12** or **0 to 18** or **0 to 30** MHz band, **TX Freq** to set in kHz the fixed frequency of the generator, **Zo RTx** (to set the Input (RX) impedance (100 Ohm or 50 Ohm or HighZ impedance) if selected **4W Bal** or **4W Umb** mode *.

After the selection, pushing the ↻ it is possible to modify the parameters by using the ▲▼ arrows.

** In **2 Wire** mode the TX impedance is the same of the RX, the High Z isn't allowed.*

Other setting:

dBm
dBm/Hz
dBr
dBV

Repeated pushing of the ***F1*** key and ↵ "Enter" the following level reading mode: **dBm**, **dBm/Hz**, **dBr** and **dBV** can be selected.

TX On
TX SW
TX Off

By repeated pushing of the ***F2*** key and ↵ "Enter" it is possible to set the generator: **TX On** (at a fixed programmable frequency), **TX SW** (sweep signal tracking with RX, **TX Off** to switch off the generator, an useful thing to measure low signals (e.g. noise level).

2W Bal
2W Unb
4W Bal
4W Unb

By repeated pushing of the ***F2*** key and ↵ "Enter" it is possible to set the measurement mode: **2 W Bal** (2 wires Balanced - mix TX/RX to measure the **Return Loss**) or **2W Unb** (2 wires Unbalanced) when **TX ON** or **TX SW** is selected, or **4W Bal** (4 wires Balanced) or **4W Unb** (4 wires Unbalanced) to to measure the Near Cross-Talk "Next", or Insertion Loss of a loop line.

Normal
MaxVal
MeanVal
MinVal

By repeated pushing of the ***F4*** key and ↵ "Enter" it is possible select the measurement mode: **Normal** or highlighting in red text the **Maximum** or **Mean** or **Minimum** input level.

G-> 0dB
G->20dB
Probe

By repeated pushing of the ***F5*** key and ↵ "Enter" it is possible to set the gain of the receiver (0 or 20 dB) to perform the measurements on High level or Low level (e.g. noise) signals, or by external HighZ **Probe** to perform the PSD on powered lines.

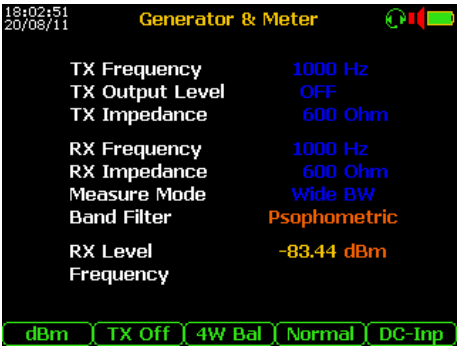
By pushing the 📷 key it is possible to freeze the measurement and, by moving the marker using the ◄ ► arrows, to read the amplitude and frequency of any point of the trace on the first two windows at the top right of the display.

By using the same key is enabled the "**Save**" function to save the measurement on internal memory, by the ✕ key is allowed the export on the USB Pen-Drive the image on the display (in BMP format).

8 Guide for generic manual transmissive measurements

8.1 - RMS Noise with Generator & Meter

The RMS Noise measurement in Base Band can be performed in wide band, or in limited band or in weighted band (with Psophometric or C-Message filter).
For this measurement it is possible to use the "RX" section of the **Generator & Meter**.



Set the instrument as follows:

- **dBm** by ***F1***
- **TX Off** by ***F2***
- **4W Bal** by ***F3***
- **Normal** by ***F4***
- **DC-Inp** * by ***F5***

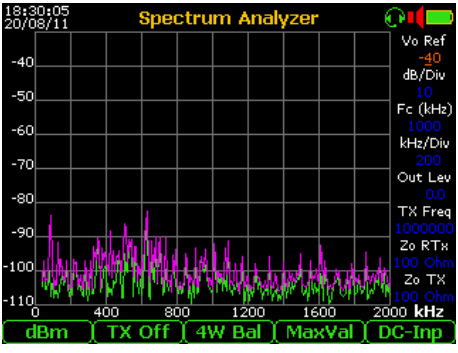
and then:

- **RX Impedance:** (eg. **600 Ohm**)
- **Measurement Mode:** (eg. **Wide BW**)
- **Band Filter:** (eg. **Psophometric**)
- Connect the line to **a-b** of the **RTX**

Read in **RX Level** the Noise level.

8.2 - Spectral Noise with Spectrum Analyzer

The spectral measurement of the Noise level, in Base or Medium Band, can be performed in limited band by the **Spectrum Analyzer**.



Set the instrument as follows:

- **dBm** by ***F1***
- **TX Off** by ***F2***
- **4W Bal** by ***F3***
- **MaxVal** by ***F4***
- **DC-Inp** * by ***F5***
- **Vo Rif** for the best trace display
- **dB/Div** for the best vertical resolution
- **Fc (kHz)** for the Base or Medium Band centre or **RX Band** (for one of the High Bands).
- **kHz/Div** for the Medium Band limit
- **Zo RTX:** (eg. **100 Ohm**)

Connect the line to **a-b** points of the **RTX** connector.
The setting made as in the example shown is used to measure the noise on the typical copper pairs for the transport of ADSL2+ stream, where the bandwidth is from few kHz up to 2 MHz (approx).
The typical value of the spectral noise on the line, near to other active lines with various digital streams, is normally under -50 ÷ -70 dBm *(see the table at the end of this paragraph).*

*Note *) this is the condition for maximum level accuracy, however if a DC Voltage (eg. line feed) is found, the front-end will be decoupled automatically by two capacitors.*

8.3 - Power Spectral Density with Spectrum Analyzer

The PSD measurement, in Medium or High Band, can be performed in limited band by the **Spectrum Analyzer** (not intrusive).

Set the instrument as follows:

- **dBm** or **dBm/Hz** by ***F1***
- **TX Off** by ***F2***
- **4W Bal** by ***F3***
- **Normal** or **MaxVal** by ***F4***
- **AC-Inp** by ***F5***

and then:

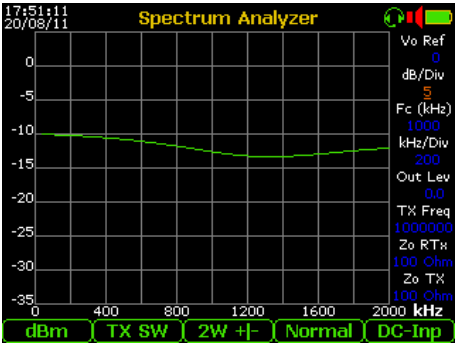
- **Vo Rif** for the best trace display
- **dB/Div** for the best vertical resolution
- **Fc (kHz)** for the Medium Band centre or **RX Band** (for one of the High Bands)
- **kHz/Div** for the Medium Band limit
- **Zo RTX: Z-High**

- Connect (in parallel) the line to **a-b** points of the **RTX** connector directly for unfed lines;
- Connect (in parallel) the line to **a-b** points of the **RTX** connector inserting the right Probe, "**ACT-15/6**" (for medium Band) or "**ACT-15/30**" (for High Band), for feed lines and select "**Probe**" by **F5**.

In the figure is shown the PSD measurement (subscriber side) of the typical ADSL stream (over POTS), in fact the line feed is shown by the little "**Vdc**" window.

8.4 - Return Loss with Spectrum/Network Analyzer

The spectral measurement of the Return Loss in any band, can be performed in limited band by the **Spectrum Analyzer**. Set the instrument as follows:



- **dBm** by ***F1***
- **TX SW** by ***F2***
- **2W +/-** (or **2W Bal** for High Band) by ***F3***
- **Normal** by ***F4***
- **DC-Inp** * by ***F5***

and then:

- **Vo Ref** to **0**
- **dB/Div** for the best vertical resolution
- **Fc (kHz)** for the Base / Medium Band centre or **RX Band** (for one of the High Bands)
- **kHz/Div** for the Medium Band limit
- **Out Lev: 0.0** and **Zo RTX:** (eg. **100 Ohm**)

Connect the line to **a-b** points of the **RTX** connector.

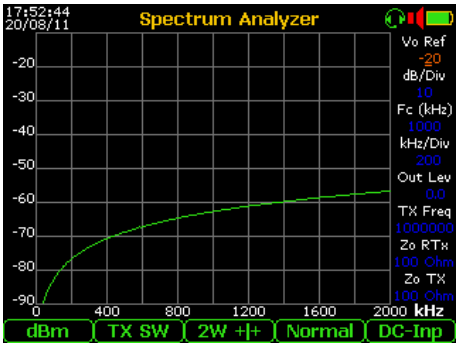
The setting made as in the example shown is used to measure the Return Loss of typical copper pairs for the transport of ADSL2+ stream, where the bandwidth is from few kHz up to 2 MHz (approx).

The typical value of the Return Loss of a loaded or >1 km long (at least) copper line is normally over 10 - 15 dB *(see the table at the end of this paragraph).*

*Note *) this is the condition for maximum level accuracy, however if a DC Voltage (eg. line feed) is found, the front-end will be decoupled automatically by two capacitors.*

8.5 - Longitudinal Balance Attenuation with Spectrum/Network Analyzer

The spectral measurement of the Longitudinal Balance Attenuation in Base and Medium Band can be performed in limited band by the **Spectrum Analyzer**.



Set the instrument as follows:

- **dBm** by ***F1***
- **TX SW** by ***F2***
- **2W +/+** by ***F3***
- **Normal** by ***F4***
- **DC-Inp** * by ***F5***

and then:

- **Vo Ref** for the best trace display
- **dB/Div** to **10**
- **Fc (kHz)** for the band centre
- **kHz/Div** for the band limit
- **Out Lev: 0.0** and **Zo RTX:** (eg. **100 Ohm**)

- Connect the line to **a - b** points of the **RTX** connector;
- Connect "**c**" point of the **RTX** connector to GND ref. (cable shield, cabinet shield etc..)

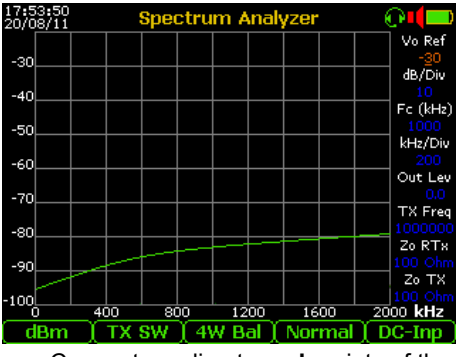
The setting made as in the example shown is used to measure the Longitudinal Balance Loss of typical copper pairs for the transport of ADSL2+ stream, where the bandwidth is from few kHz up to 2 MHz (approx).

*Note *) this is the condition for maximum level accuracy, however if a DC Voltage (eg. line feed) is found, the front-end will be decoupled automatically by two capacitors.*

8.6 - Near End Crosstalk "NEXT" with Spectrum Analyzer

The spectral measurement of the NEXT in any band, can be performed in limited band by the **Spectrum Analyzer**.

This measurement must be performed between two lines of the same cable to verify the transmissive insulation. Set the instrument as follows:



- **dBm** by ***F1***
- **TX SW** by ***F2***
- **4F Bil** by ***F3***
- **Normal** by ***F4***
- **DC-Inp** * by ***F5***

and then:

- **Vo Ref** for the best trace display
- **dB/Div** to **10**
- **Fc (kHz)** for the Base / Medium Band centre or **RX Band** (for one of the High Bands)
- **kHz/Div** for the Base or Medium band
- **Out Lev: 0.0** and **Zo RTX:** (eg. **100 Ohm**)

- Connect one line to **a - b** points of the **RTX** connector;
- Connect the other (disturbing) line to **a - b** points of the **TX** connector.

The setting made as in the example shown is used to measure the NEXT on typical copper pairs for the transport of ADSL2+ stream, where the bandwidth is from few kHz up to 2 MHz (approx).

8.7 - End-to-End manual Insertion Loss measurement

Usually the Insertion Loss measurement (or line attenuation vs frequency) can be performed with a pair of instruments connected at the opposite ends of the line under test.

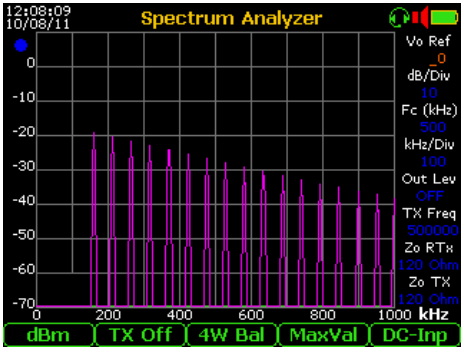
With the **Generator & Meter** function of two ACT6000 it is possible to perform this measurement at a single frequency, by suitable setting of all the parameters (see the Generator & Meter description and instructions).

Usually the **Generator** Output (**a-b** of the **TX** connector) must be connected to the remote end of the line, and the **Meter** Input (**a-b** of the **RTX** connector) must be connected to the local end of the line.

For the spectral mode measurement it is necessary to use the **Spectrum Analyzer** function as meter and **Step Generator** as reference signals generator.

Below is described the operation mode.

Meter setup



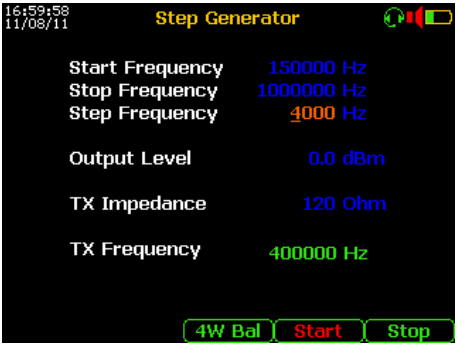
First of all it is necessary to define the operating band by setting the **Fc** (Central Frequency) and span by the **kHz/Div**.

To hold the peak levels on the display it is necessary to set the "**Max Val**" by the ***F4***.

To do a quick test, useful to estimate the attenuation vs frequency (see the image at the left), it is suggested to set the Step Generator with "wide" steps (eg. 4 kHz), in this case the test time will take a few seconds.

To get a continuous trace it is necessary to set the Step Generator with very small steps (eg. 200 Hz) but the time test for the same band will increased to over 15 minutes.

Step Generator setup



To perform the spectral Insertion Loss measurement using the Spectrum Analyzer at the opposite end of the line under test, set the "**Start Frequency**" and "**Stop Frequency**" and then set the "**Step Frequency**" (from 10 to 1000 Hz for Base Band and from 10 to 8000 Hz for the Medium Band).

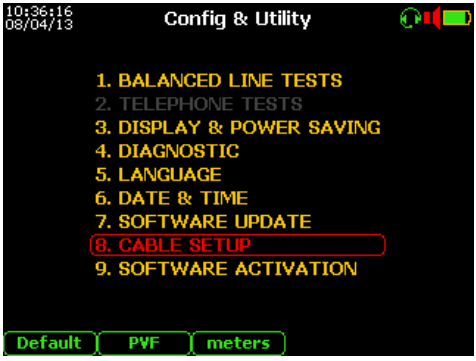
Set the right "**TX Impedance**" (from 200 to 600 Ohm for Base Band and from 100 to 150 Ohm for Medium Band) and if needed the **Output Level**.

Press ***F4*** "**Start**" to start the sweep, the frequency progress of the output signal is shown (in green) in the "**TX Frequency**" field.

After the complete sequence (from Frequency Start to Frequency Stop), press ***F5*** "**Stop**" to finish the test.

9 Configurations and Utilities

This item allows the selection of sub-menus to configure the instrument.
From the **Main Menu** select **7.Config & Utility**



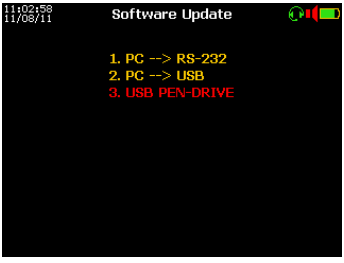
1. **BALANCED LINE TESTS** described on the Par. 11 – Appendix 1, to configure the parameters for the automatic line tests (by Advanced Software 1).
2. **TELEPHONE TESTS** (available with the Advanced Software 2)
3. **Display & Power Saving** (to set the screen Brightness and Contrast *inside this menu, pushing the **F1** key it is possible to invert the screen background (from black to white) useful to very floodlit environment.*
4. **Diagnostic** (reserved to ATEN's Authorized Service Laboratories)

5. Language

6. Date & Time

7. Software Update

Below is the information to perform the **Software Update**



- Switch-Off the instrument and insert to the USB port the Pen-Drive loaded with the new software named Flash_en.BIN".
- Switch-On the instrument and from the **Main Menu** select and enter on the "**7. Config & Utility**" menu, then select the item "**3. USB PEN-DRIVE**" and push "**Enter**".

The new software will be automatically captured from the Pen-Drive. Push "**Enter**" to confirm the load and the progress of the upload will be shown.
At the complete loading, when will appear "**You Can Now Restart**", it is necessary to restart the instrument by Power-Off and Power-On.

ATTENTION ! After every software update it is necessary to set the instrument to the original (default) configuration: from the **Main Menu** select and enter into "**7 - Config & Utility**" menu, then select push ***F1*** "**Default**" and "**Enter".**
The instrument is ready to work!
Pressing [?] from the Main Menu it is possible to verify the installed software release.

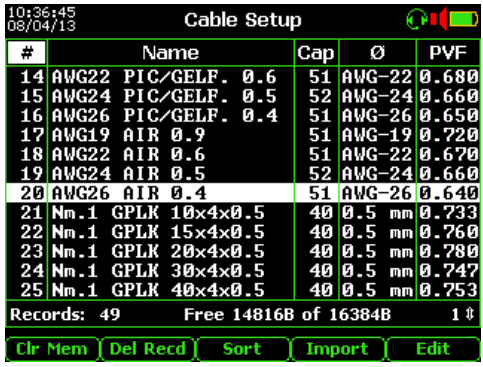
Function keys
F1 **"Default"** to restore some test parameters to the original factory setup.

F2 "**PVF**" to personalize propagation velocity factor unit for the TDR: **PVF** or **V** or **V ½.**

F3 "**meters**" to personalize units of the lengths.

8. Cable Setup

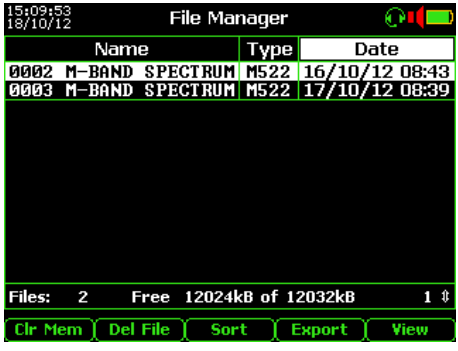
By this menu it is possible to select from the wide **data-base** the cable type to be test: usual Name (dielectric type), typical Capacitance/km, Wires Diameter (with typical resistance/km), and typical PVF.
Selecting the preponderant cable by ▲▼ arrows and pushing "**Enter**" the reference cable will be automatically pre-configured for various measurements or functions as TDR, Capacitance length, Resistance, Fault location etc.
A new cable type can be create using the ***F5*** "**Edit**" typing the relate parameters into the apposite fields.



The file of the above mentioned **data-base**, continually updated, it is free downloadable (together the Software Release) from this web page: http://www.aten.it/Applications.html . Extract and copy the file "cabledat.csv" on the USB Pen-drive, insert it on the USB port of the instrument then push ***F4*** "**Import**" from this menu.

9. **Software Activation** to install the optional software module.
Loaded on the Pen-Drive the software module and its code, connecting the Pen-Drive to the USB port, selecting this menu the software will be automatically activated.

10 File Manager



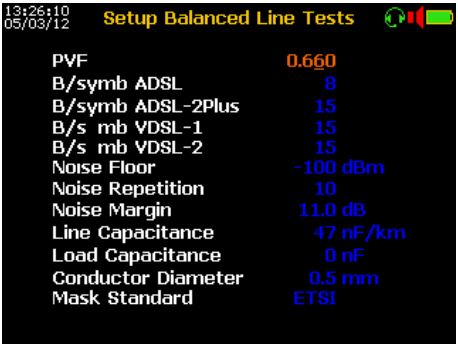
From the Main menu select the "**6. File Manager**".
All the measurements saved in the memory, they can be seen and/or exported to the USB Pen-drive.
Select the measurement by the ▲▼ arrows; then push ***F5*** "**View**" to re-show,
or ***F4*** "**Export**" to export in CSV format.
By ***F1*** and ***F2*** keys it is possible to erase the memory o a single file.
By ***F3*** key it is possible organize the files list by "**Date**"or **Name** (file number).

11 Appendix 1 - Pre-configured Single End Line Testing Sequences

By the "**Advanced Software 1**" and **DMM module** it is possible to perform a complete line qualification with single ACT6000 placed at C.O. MDF or Street Cabinet.
To perform this test is necessary disconnect any xDSL or active device (modem, router or cordless) at the opposite side of the line to be test.
Connect the line to the "**a**" and "**b**" points and "earth" (GND) reference to the "**c**" point of the **RTX** connector; if needed also the Cross-Talk measurement, connect the second line to the "**a**" and "**b**" point of the **TX** connector.
Disconnect the AC/DC battery charger.

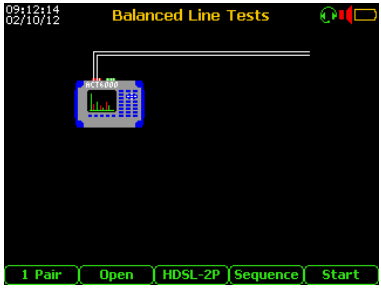
Before the Test Configuration is suggested to verify (by TDR in manual mode) **correct the echo of the "end line"** from which it is possible to verify the congruence of the presumed line length after the selection of the preponderant cable type (see **8. Cable Setup** at page 34).

Special Instrument Configuration (alternative to the selection of the cable type).
From the **Main Menu** select and enter on the "**7. Config & Utility**" menu, then select and enter on the "**1. BALANCED LINE TEST**", and:



- Set the presumed PVF value for the right automatic Line-End estimation by TDR.
- Set the Bit/Symb for the right ADSL or VDSL* Bit-Rate evaluation.
- Set the presumed far-end Noise Floor.
- Set the Noise measurement repetition **.
- Set the Noise Margin for the right ADSL or VDSL** Bit-Rate evaluation.
- Set the presumed Line Capacitance value
- Set the presumed Conductors Diameter (select by the ◀ ▶ arrows the standard "AWG" or "mm") ***
- Set the ETSI or ANSI standard masks.

*Note * with the adoption of the EBM30 optional module.*
*** Increasing the Noise Repetition test, from 1 (short time) to 60 (long time), the accuracy of the final RMS Noise measurement will be increased.*
**** to increase the accuracy of the SELT Insertion-Loss is suggested to adjust (before) the correct copper resistance value (Ohm/km) of the line under test by the R-Set (page 22).*



Test configuration

From the **Main Menu**, select and enter the **1. Line Tests** item, then select and enter on **1. BALANCED LINE TESTS**, and:

by ***F1*** key select **1** or **2 Pair** mode.
2 Pairs allows to perform also the NEXT (Near Cross Talk) measure.
In this case the tracking reference signal (to disturb) is available on the TX connector.
About the ***F2 key*** note that with the "Advanced Software 1" is enabled only line "**Open**" choice.

By ***F3*** key it is possible to select the transmissive measurements related to the specific mask and threshold limits (with pass/fail indication):

- **ISDN**, **HDSL**, **SHDSL**, **E1** and **T1** on Medium Band referring to the right limited band and single ref. frequency by Nyquist formula.

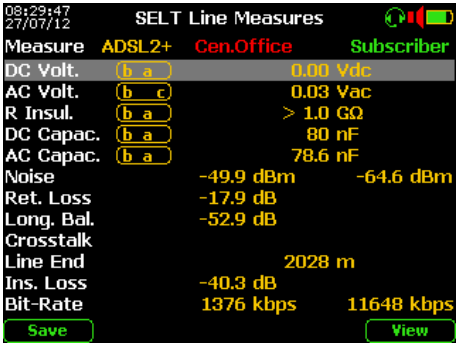
- **ADSL**, **ADSL2+, VDSL2** on Medium or High Band referring to the right limited band and frequency marked on 300 kHz for ADSL, 1.1 MHz for ADSL2+ and xxx kHz for VDSL 2 if the EBM30 module is installed.

Automatic SELT start

Push the ***F5*** "**Start**" key to perform the Single-End-Line-Test sequence.

Warning! During the sequence don't manage the line (a-b) or "ground" (c) connections.

Test results *(after about 90 seconds from the start)*



During the test sequence is shown step by step any single electric value measured between **b** - **a** and **c** points.

For the extraneous AC/DC Voltages and low Resistive Insulation (among **b**-**a**-**c** points) are shown the worse values, as highlighted on the image at left for the low insulation value between **b** - **a** points.

All the transmissive measurements are only between **b**-**a** points.

Under the "Subscriber" column are shown the estimated values (i.e. Far-end Noise* and ADSL down stream estimation).

Finished the automatic test, pushing the ***F1*** "**Save**" it is possible to save the summarizing table and all the hidden details (spectral / graphics responses included) on the internal memory. By pushing the [X] "Clear" key, it is possible to export the screen-shot to the USB Pen-drive in .BMP format.

***Noise note**: The results of the Noise RMS (local and remote estimation for the ADSL, ADSL2+ and VDSL2) are weighted with the right filters depending to the selected line service and masks (i.e. "G2" for the ADSL2+).*

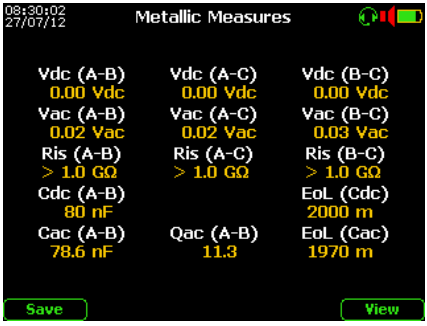
Note: Pass/Fail indications

*If some measured value is out of the preconfigured threshold limits the value will be shown in **red**.*

*- When the **DC Capacitance** value is abnormal (i.e. ≥ 700 nF) and highlighted, it is probable that the line is terminated with one or more telephones or similar POTS devices (due the ring capacitor)*

*- When the **line length** estimated by TDR is incongruent with the typical AC or DC line capacitance or however it is out of the TDR range, the **Line End**, **Ins. Loss** and **Bit-Rate** results can be wrong and will be highlighted in **red**.*

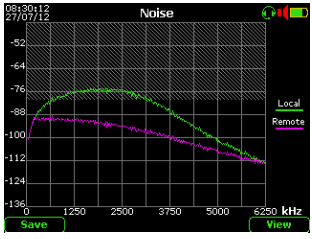
Details visualization



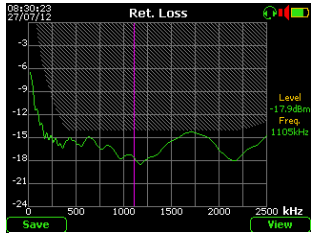
Selected a Metallic Measure on previous menu, by pushing the ***F5*** "**View**" key it is possible to open a page where are detailed all the measured electric values as at left shown:

- AC (as AC line power influence);
- DC Voltage, Resistive Insulation;
- DC and AC line Capacitance, both with the estimated Line Length "EoL" related to the previous setup on the "Config. & Utility" menu.

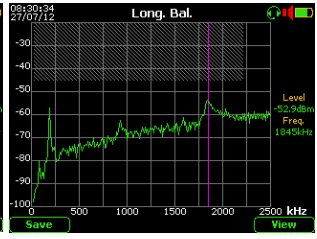
By pushing ▶ arrow it is possible to view the graphs of other transmissive measurements, as follows:



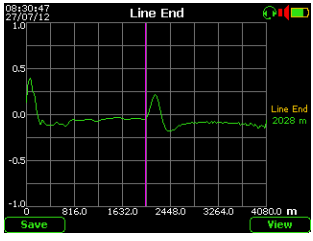
Local Noise and its remote estimation, transferred to the presumed noise floor.



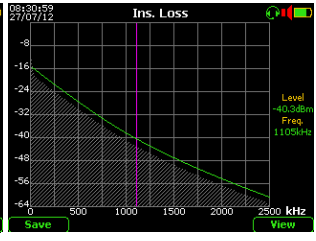
Return-Loss with marker on the related frequency reference (1.1 MHz).



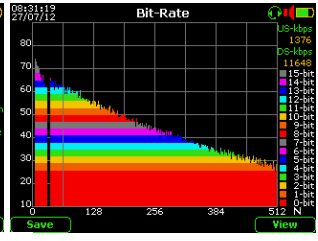
Longitudinal Balance Loss with marker on the worse value of the band.



TDR echogram with marker on estimated Line End (open) at 2028 m.



Insertion Loss with marker on the related frequency reference (1.1 MHz) *.



Signal-to-Noise Ratio where are highlighted any DMT channel amplitude (bit rate).

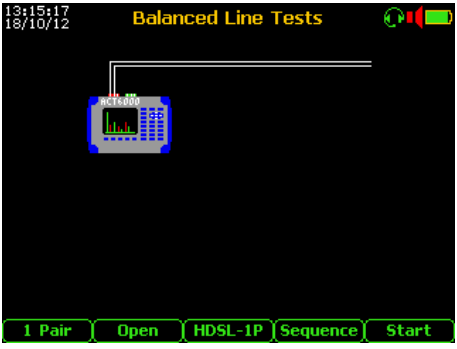
**** Insertion Loss note**: The threshold limit (decreased of 2 dB) is referred to the typical good line with same length, capacitance and gauge wires.*

Pushing the ***F1*** "**Save**" it is possible to save the any graph on the internal memory.
By pushing the [X] "Clear" key, it is possible to export the screen-shot on USB Pen-drive in .BMP format.

11.1 Appendix 2 – Pre-configured single transmissive measurements

By the adoption of the “Advanced Software 1”, and with one ACT6000 c/o Central MDF, Cabinet or User side, it is possible perform a single pre-configured transmissive: **Noise**, **Return-Loss**, **Longitudinal Balance-Loss** and **NEXT** measurement for these services: **ISDN**, **HDSL 1** e **2 P**, **SHDSL**, **E1** or **T1**, **ADSL**, **ADSL2+** and **VDSL2**.
Connecting the instrument in parallel to the active line, it is possible to perform the PSD (Power Spectral Density)

Procedure



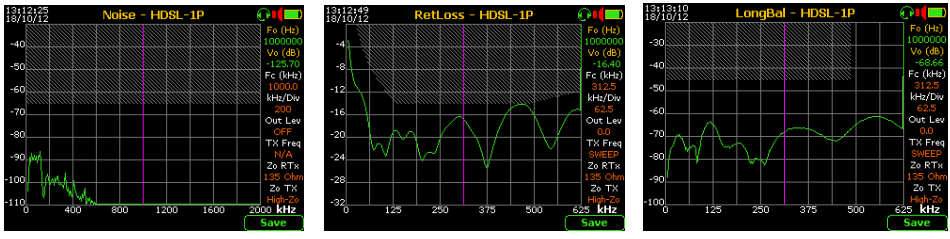
From the **Main Menu**, select and enter on “**1. Balanced Line Tests**” menu.
- By the ***F3*** key select the service type;
- by the ***F4*** key select the measurements type (excluding the “Sequence”).

To perform any test (excluding the PSD) connect the line to the “**a**” and “**b**” point of the **RTX** connector and the “earth” (Gnd) to the point “**c**”.

- Push the ***F5*** key to start the test.

By ***F1*** key select the **1 Pair** or **2 Pairs**.
The “**1 Pair**” is the normal mode operation with a single line.
The “**2 Pairs**” allows to perform the NEXT (Near Cross-Talk) measurement, in this case it is necessary to connect the second (disturbance) line to the “**a**” and “**b**” point of the **TX** connector.

Pushing the ***F5*** “**Start**” the measurement is activated and updated every second.
This test mode is very useful when a quick test is necessary to verify the quality and cleaning of the line under test, also to select the best lines.



By pushing the [Photo] “Photo” key, the measurement can be temporary frozen and a special function-key will be enabled to save the measurement on the internal memory.
By pushing the [Return] key the measurement will be reactivated.

Pushing the [Cancel] (Cancel) key it is allows the immediate export of the screen shot to the Pen-Drive (image in BMP format).