

ET91

100 Hz - 2400 kHz



Four instruments in one for PLC, FDM and communication line testing

ET91

2.4 MHz selective level meter and generator

amperis

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General description



Front view of the ET91.



Main menu: manual tests, master and slave modes, and utilities.

Four instruments in one

ET91 is a hand-held, battery-operated instrument that combines a level generator, a selective and wideband level meter from 100 Hz to 2400 kHz, a measuring bridge and a high-resolution spectrum analyzer. It is designed for testing power line carrier (PLC), frequency division multiplexing (FDM), audio tone and FSK communication systems, and for characterizing cables and voice channels.

No frequency calculation

FDM test instructions often specify the test frequency as carrier $\pm$ tone. ET91 sets the carrier and the audio frequency separately, in carrier + tone and carrier - tone formats, so there is no need to calculate the receive frequency. In the tracking modes, the generator controls the selective level meter: only the transmit frequency is set, and the receiver tunes to the carrier $\pm$ the transmitted frequency.

Applications

- Commissioning and maintenance of power line carrier (PLC) links and FDM systems.
- Measurement of level, noise, carrier leak, crosstalk and non-linear distortion in voice channels.
- Cable characterization: loss, longitudinal balance, impedance, return loss and crosstalk.
- Interference location and power spectral density analysis.



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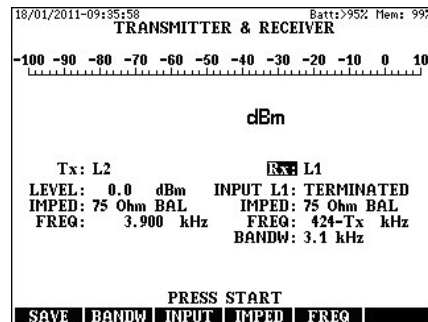
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Generator and level meter



Selective receiver with level limits.



Transmitter and receiver in tracking mode.

Selective level meter

It receives a single frequency or a multi-tone test signal (MTTS) between 100 Hz and 2400 kHz, with 2 ppm $\pm$ 1 Hz accuracy and 1 Hz setting steps. Five bandwidths -20 Hz, 200 Hz, 1.74, 1.95 and 3.1 kHz- cover noise, carrier leak, crosstalk and non-linear distortion measurements, with a range of -120 to +10 dB and results in dB, dBm, dBr or mV. Maximum and minimum limits give an immediate PASS/FAIL indication.

Wideband receiver

Six selectable band filters, from 100 Hz-4 kHz to 24-2400 kHz, with auto ranging. The balanced and coaxial inputs accept 75, 135 (125) and 150 Ω or high impedance between 10 and 2400 kHz, and 600 Ω or high impedance below 10 kHz.

Generator

It generates a quartz-accurate test signal with 1 Hz resolution, as a single frequency, a multi-tone signal (MTTS) or a sweep. The balanced output delivers +10 to -60 dBm (up to +20 dBm below 10 kHz) and the coaxial output +10 to -60 dBm, with 0.1 dB resolution and $\pm$ 0.3 dB accuracy.

Tracking modes

In synchronous tuning, the receiver follows the transmitter frequency. In the FDM channel mode, the instrument transmits at the audio input of the channel and measures in the carrier band, with a receive frequency equal to the carrier $\pm$ the transmitted frequency.



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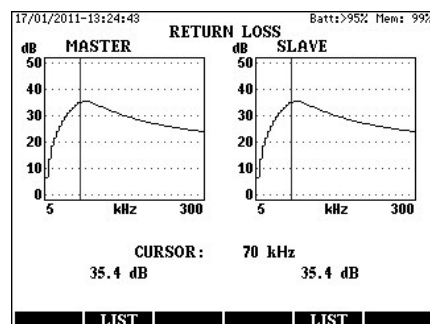


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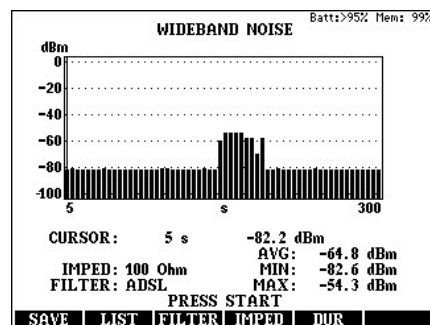
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Measuring bridge, noise and spectrum



Return loss versus frequency (master and slave).



Wideband noise histogram.

Built-in measuring bridge

It measures longitudinal balance (LCL) from 0 to 70 dB under ITU-T Rec. O.9, return loss from 0 to 40 dB and impedance from 50 to 1600 Ω , all versus frequency. The crosstalk and loss measurement (NEXT/LOSS) reaches 80 dB across the whole 100 Hz to 2400 kHz band.

Wideband and impulse noise

The psophometer measures voice-channel noise under ITU-T Rec. O.41, and the wideband measurement adds eight filters from 3.1 to 2400 kHz. Measurements last from 1 s to 72 h: up to 1 min they are shown quasi-analogue and from 5 min as a 60-slot histogram. The impulse noise counter detects pulses longer than 500 ns, with a 1 to 500 mV threshold and up to 65,000 counts.

High-resolution spectrum analyzer

It analyzes from 100 Hz to 2400 kHz in six spans, from 2.4 MHz with 500 Hz to 8 kHz resolution down to 4 kHz with 10 to 20 Hz resolution, and plots 300 frequencies with sensitivity down to -140 dBm/Hz. The trace is evaluated in NORM, PEAK, AVG and SAVG modes, in dBm or dBm/Hz, to check output power spectral density, crosstalk and other interfering signals.

End-to-end measurements and options

AUTOMATIC TEST		
TEST		
LOSS	L1	
NOISE	L1	
RET. LOSS	L1	
IMPEDANCE	L1	
BALANCE	L1	
FEXT	L2=>L1	
NEXT	L2=>L1	

SLAVE:
READY

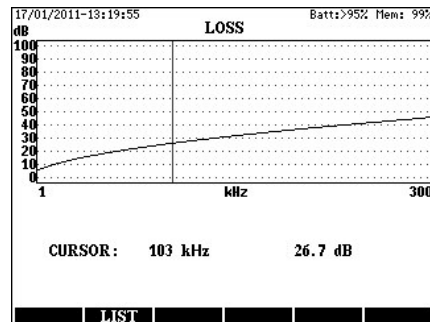
MEASURING TIME:

IMPED: 150 Ohm BAL
RANGE: 600 kHz

PRESS START

SAVE IMPED RANGE

Automatic master-slave test program.



Cable loss versus frequency.

Master-slave mode

Two instruments, one at each end, automatically measure carrier cables and voice channels. The master initiates the measurements and collects the results; the slave performs them on the master's commands and sends back the values, and both communicate over the line under test. The automatic program covers loss, noise at both ends, return loss, impedance, balance (LCL), near-end crosstalk (NEXT) and far-end crosstalk (FEXT).

Software options

- Group delay distortion with a 37-tone signal, from 0 to 10 ms with 1 μ s resolution, under ITU-T O.81.
- Phase jitter (ITU-T O.91) from 0.2 to 30° p-p and frequency error of ± 30 Hz.
- Micro interruptions from 0.6 ms to over 1 min, in five categories, over 4 min to 72 h.
- Spectrogram and spectral trace as reference.

Hardware options

External 40 dB attenuators, coaxial and balanced, for levels up to +40 dB between 10 and 2400 kHz with ± 0.5 dB accuracy, and a 12 V car power adapter.

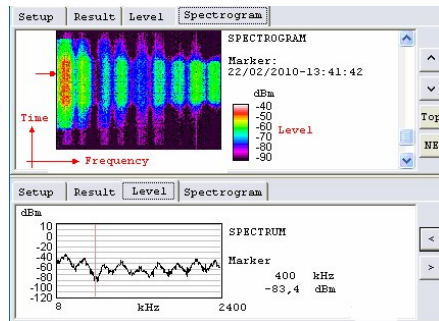


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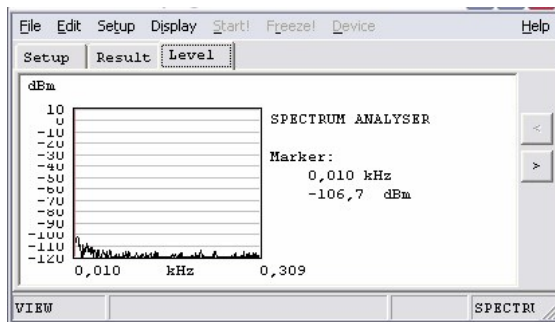
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Memory, software and power



Spectrogram in the PC software.



Spectrum transferred to the PC software.

Test setup and result memory

To speed up routine tests, the instrument stores 100 user-defined test setups -with generator and level meter parameters and PASS/FAIL limits- and 100 results.

Two USB ports

The USB A port takes a USB stick (FAT16 or FAT32) to exchange results and setups with a PC without installing any driver, which helps users who have no administrator rights. The USB B port connects the instrument directly to the PC.

PC software

The PC software transfers results and displays them numerically and graphically, produces test protocols in selectable size and file format, and prints them. Its editor creates test setups and sends them to the instrument memory; it also shows the hardware and software versions and the calibration date, and remote-controls the spectrogram with continuous result transfer during the measurement.

Battery life and display

The internal NiMH battery gives about 8 hours of operation and is recharged in place in less than 3 hours with the mains or car adapter. The 320 × 240 dot graphic TFT display is backlit, and menus are available in English, German or Russian.

ET91 – SPECIFICATIONS · GENERATOR AND RECEIVERS

Generator modes	Single frequency (1 FREQ) and multi-tone test signal (MTTS)
Generator frequency	100 Hz - 2400 kHz in 1 Hz steps; accuracy 2 ppm $\pm$ 1 Hz
Balanced and coaxial outputs	10 - 2400 kHz: $\sim$ 0, 75, 135 (125) and 150 Ω ; 100 Hz - 10 kHz: $\sim$ 0 and 600 Ω
Balanced output level	10 - 2400 kHz: +10 to -60 dBm; 100 Hz - 10 kHz: +20 to -60 dBm
Coaxial output level	$\sim$ 0, 75, 135 (125) and 150 Ω : +10 to -60 dBm; 600 Ω : +4 to -60 dBm
Generator level: resolution and accuracy	0.1 dB; $\pm$ 0.3 dB at 0 dBm (f > 200 Hz)
Selective receiver modes	Single frequency (1 FREQ) and multi-tone test signal (MTTS)
Selective receiver frequency	100 Hz - 2400 kHz; direct setting in 1 Hz steps; accuracy 2 ppm $\pm$ 1 Hz
Carrier $\pm$ tone setting	Carrier 4 - 2396 kHz in 1 kHz steps; tone 100 Hz - 3.9 kHz in 1 Hz steps
Bandwidths	200 Hz - 10 kHz: 20 Hz; 10 - 2400 kHz: 20 Hz, 200 Hz, 1.74, 1.95 and 3.1 kHz
Balanced and coaxial inputs	10 - 2400 kHz: 75, 135 (125), 150 Ω or high impedance; 100 Hz - 10 kHz: 600 Ω or high impedance
Selective measuring range	-120 to +10 dB with 20 Hz bandwidth
Receiver level: resolution and accuracy	0.1 dB; $\pm$ 0.3 dB at 0 dBm (f > 200 Hz); units dB, dBm, dBr and mV
Wideband receiver filters (3 dB)	100 Hz - 4 kHz: -100 to +10 dB; 1.2 - 120 kHz and 3 - 300 kHz: -90 to +10 dB; 6 - 600 kHz: -80 to +10 dB; 12 - 1200 kHz and 24 - 2400 kHz: -70 to +10 dB
Wideband receiver: resolution and accuracy	0.1 dB; $\pm$ 0.3 dB at 0 dBm (f > 200 Hz)
Receiver-transmitter tracking	Synchronous tuning (Rx = Tx) or FDM channel: Rx = carrier $\pm$ Tx, with Tx from 100 Hz to 3.9 kHz and carrier from 4 to 2396 kHz

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ET91 – SPECIFICATIONS · BRIDGE, NOISE AND SPECTRUM

Crosstalk and loss (NEXT/LOSS)	100 Hz - 2400 kHz; output 75, 135 (125), 150 Ω or 600 Ω ; input the same or high impedance; up to 80 dB
Longitudinal balance (LCL)	75, 135 (125), 150 Ω (10 - 2400 kHz) or 600 Ω (200 Hz - 10 kHz); 0 - 70 dB; accuracy at 40 dB: ± 2 dB (200 Hz - 10 kHz), ± 1 dB (10 - 2400 kHz)
Return loss	Nominal Z 75, 135 (125), 150 Ω or 600 Ω ; limits Z/2 to 2Z; 0 - 40 dB; accuracy at 20 dB: ± 2 dB (200 Hz - 10 kHz), ± 1 dB (10 - 500 kHz), ± 2 dB (500 - 2400 kHz)
Impedance	50 - 1600 Ω between 200 Hz and 2400 kHz; accuracy $\pm 5\% \pm 5 \Omega$
Wideband noise: frequency and filters	100 Hz - 2400 kHz; psophometric, 3.1, 4, 20, 120, 300, 600, 1200 and 2400 kHz
Wideband noise: times	1, 5, 10, 30 s; 1, 5, 10, 30 min; 1, 2, 4, 8, 12, 24, 48 and 72 h
Wideband noise: evaluation	Quasi-analogue from 1 s to 1 min; 60-slot histogram from 5 min to 72 h
Impulse noise	Pulses > 500 ns; interval > 10 ms; threshold 1 - 500 mV; up to 65,000 counts
Impulse noise: times and evaluation	1 s to 72 h; numeric up to 30 s and 60-slot histogram above
Spectrum analyzer: frequency	100 Hz - 2400 kHz; 75, 135 (125), 150 Ω or high impedance (10 - 2400 kHz); 600 Ω or high impedance (100 Hz - 10 kHz)
Spans and resolution	2.4 MHz: 500 Hz - 8 kHz; 1.2 MHz: 500 Hz - 4 kHz; 600 kHz: 500 Hz - 2 kHz; 300 kHz: 500 Hz - 1 kHz; 20 kHz: 50 - 100 Hz; 4 kHz: 10 - 20 Hz
Spectrum display	Down to -140 dBm/Hz; 300 frequencies; NORM, PEAK, AVG and SAVG evaluation; dB, dBm, dBm/Hz and dBr

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ET91 – OPTIONS AND GENERAL DATA

Group delay (option)	37-tone signal from 200 to 3700 Hz, 100 Hz step; 600 Ω ; output -30 dB/tone; input -60 to -20 dB/tone; 0 - 10 ms, 1 μ s resolution; accuracy under ITU-T O.81
Phase jitter and frequency error (option)	1020 Hz signal, 0 to -30 dBm; jitter (O.91) 0.2 - 30.0° p-p, 4 - 300 Hz filter; frequency error $\pm$ 30 Hz, 0.1 Hz resolution
Micro interruptions (option)	1020 Hz, 0 to -30 dBm, 600 Ω ; threshold 3, 6, 10 or 20 dB below normal level; 4 min to 72 h; categories from 0.6 ms to over 1 min; relative duration, errored seconds and distribution
External 40 dB attenuator (option)	10 - 2400 kHz; accuracy $\pm$ 0.5 dB; max. input +40 dB; > 3.7 k Ω coaxial; balanced output
Power supply	Internal NiMH battery; approx. 8 h operation; fast charging in less than 3 h with mains (100 - 264 V AC) or car (12 V) adapter
Display	320 $\times$ 240 dot graphic TFT-LCD, backlit; English, German or Russian menus
Connectors	L1 and L2 balanced (4 mm sockets) and coaxial (BNC); ground (4 mm socket); active probe supply (Mini-DIN 4P)
USB	USB A 1.1 for USB stick (FAT16/FAT32); USB B 1.1 for PC
Overvoltage protection	200 V DC between a and b or ground; longitudinal voltage 60 V AC
Temperature	Reference 23 $\pm$ 5 °C; operation 0 to +40 °C; limits -5 to +45 °C; storage and transport -40 to +70 °C, non-condensing
Dimensions and weight	224 $\times$ 160 $\times$ 44 mm; approx. 1.5 kg including battery

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ET91 – SUPPLY AND OPTIONS

Standard supply	Instrument with built-in battery, operating manual, short form instructions, calibration certificate, 2 balanced measuring cables, 2 coaxial measuring cables, USB cable, USB stick, mains adapter (100 - 264 V AC) and carrying case
Hardware options	External 40 dB coaxial attenuator; external 40 dB balanced attenuator; 12 V car power adapter
Software options	Group delay distortion; phase jitter and frequency error; micro interruptions; spectrogram; spectral trace as reference
PC software	Result transfer and processing, test protocols, setup editor, instrument status check and spectrogram control
Services	Calibration report

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