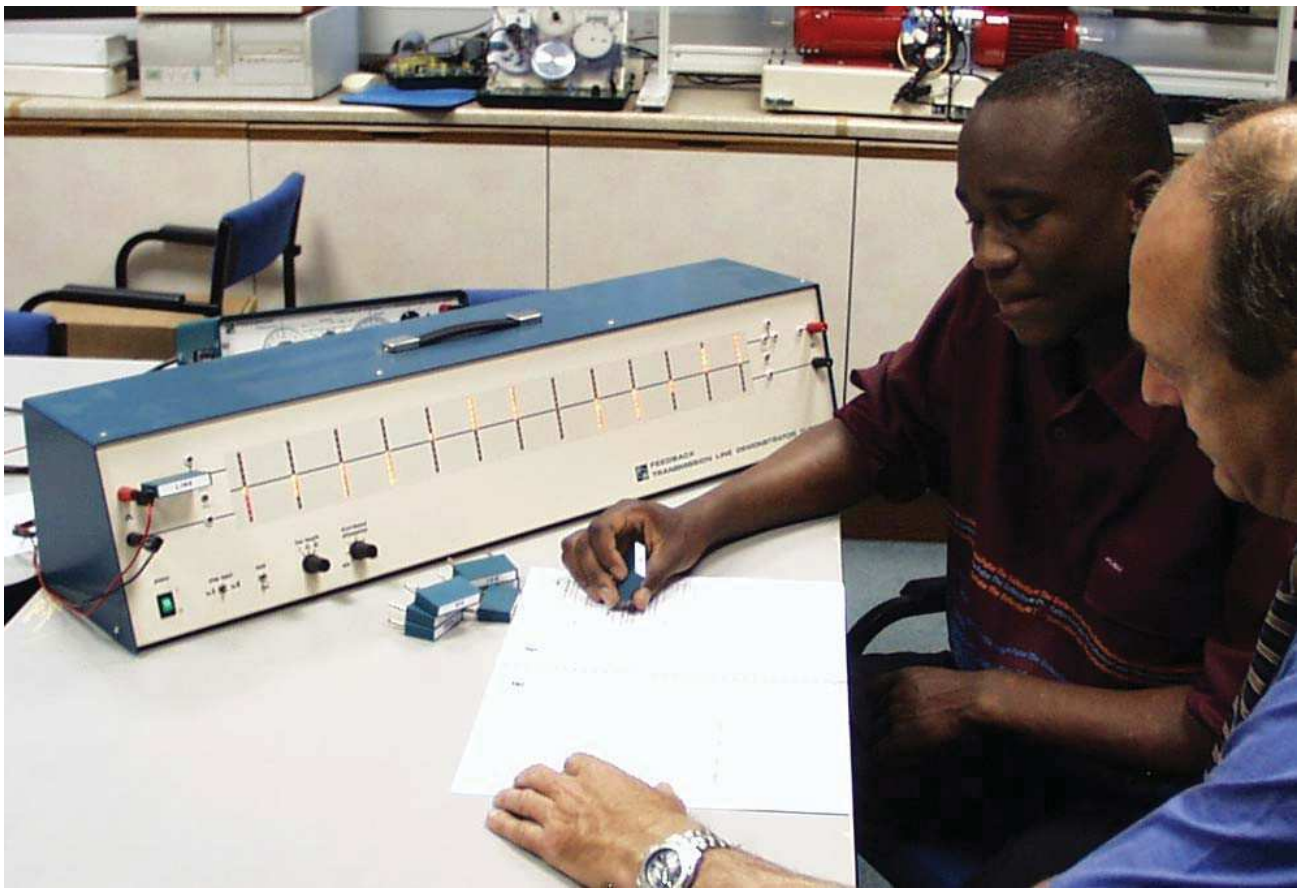
Transmission Line Demonstrator TLD511



Description

The Transmission Line Demonstrator TLD511 visually clarifies transmission line concepts by graphically displaying, at low frequency, the characteristics of a transmission line.

For students of communications engineering, the TLD511 provides an ideal demonstration of line characteristics and wave motion. Demonstrating these characteristics has been a problem in the past because of the high transmission speeds involved. Now, by using a simulated line, the TLD511 Demonstrator effectively displays at low frequencies the high frequency characteristics of a transmission line so that students can easily observe them. The operator can also readily adjust them. The line is completely symmetrical so that either end may be regarded as the input or output.

Although primarily designed to illustrate features common to electrical lines operating at power audio and radio frequencies, the TLD511 can also be used to teaching other subjects, such as acoustics.

Features

- Large bright LED display
- Built-in step function generator
- Variable simulated line length
- Manual hold facility
- Comprehensive instruction manual

The Equipment

The Transmission Line Demonstrator TLD511 has been designed to reproduce at low frequencies the essential characteristics of a transmission line, which would normally only be observed by more complex equipment operating at high frequencies. It comprises a self-powered simulated transmission line for bench mounting. The front panel houses indicators related to a mimic diagram of the line and its terminations.

The line is represented by a 13-section illuminated display, 0.6 metres in length. Electrical potentials are displayed on columns of LEDs which are equally spaced along the simulated line. The columns light from the centre outward, indicating the polarity and magnitude of the voltage present at that point on the transmission line - upward denoting a positive voltage, downward negative. There is an attenuation control, which acts equally on all parts of the line and gives continuous adjustment from nearly lossless to high loss condition. A manual hold facility is provided which allows the display to be held at any point. The simulated lines length can be switched to values L, 2L and 8L. The corresponding propagation times are 0.25 s, 0.5 s and 2 s.

The wave velocity 4L per second is chosen so that the progress of a wave along the line can be easily observed. A step function generator is provided enabling a pulse or steady dc level to be applied to the line at either end. A set of plug-in terminating impedances (including a capacitor) is supplied. These may be connected either in series or in parallel with the line terminations, which are 4 mm socket/binding posts. All the features of line performance mentioned, except the impedance of the line, can be demonstrated with no more additional equipment than a sine-wave generator. The frequency range required is 0.1 Hz to 10 Hz, variable up to.

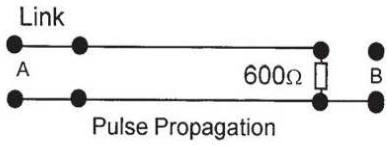
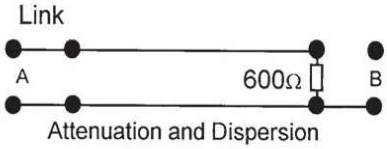
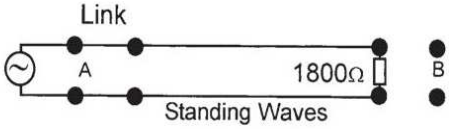
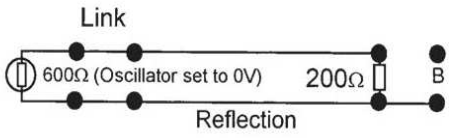
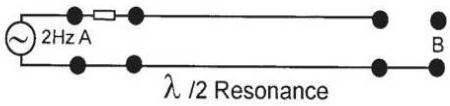
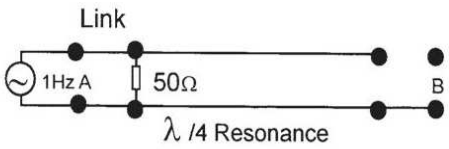
Demonstrations and assignments

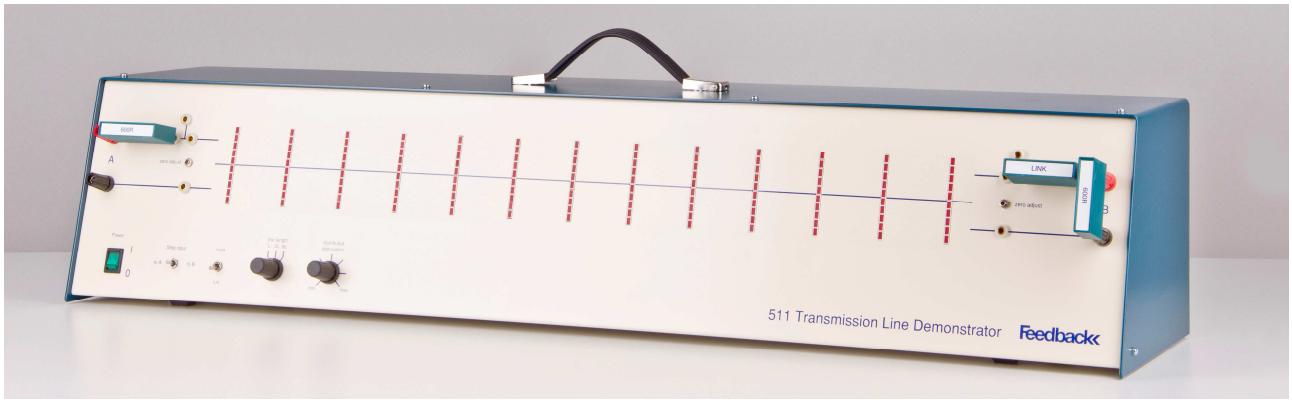
All of the demonstrations described in the manual may be used for classroom demonstration.

Demonstrations 4, 5 and 6 have been set out in a form suitable for use by students as assignments to be carried out individually or in small groups.

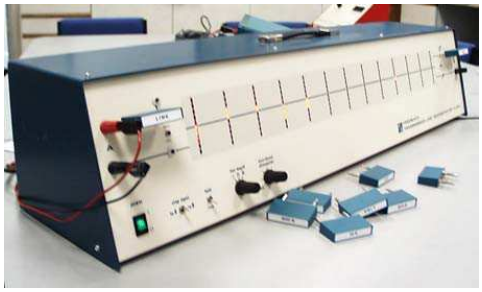
They are listed here with an example experimental set-up. In addition to these demonstrations, application notes describe how the TLD511 can be used with the bridge circuits formed from ordinary laboratory apparatus to show the determination of the characteristic impedence by open and short- circuit measurements, and the impedance-transforming property of a λ/4 line in more detail.

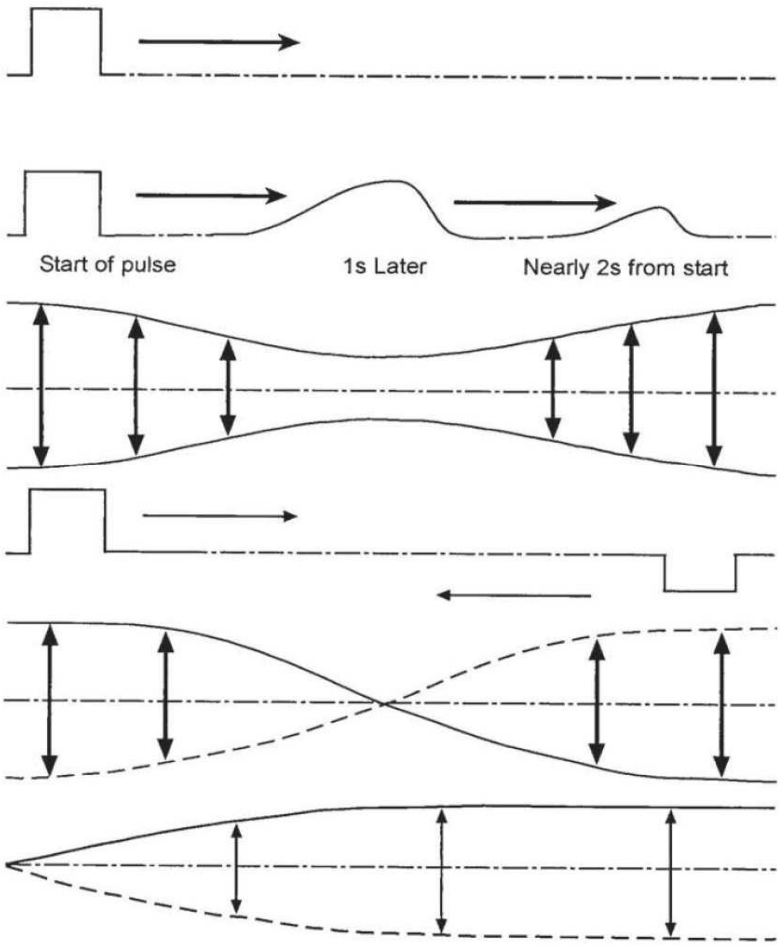
The physical design of the TLD511 makes it ideal for the classroom or laboratory demonstration use. The LED display is particularly effective when viewed from about five metres, the wave motion being the most realistically displayed.

Typical demonstrations	
Propagation of a wave front and of a sine wave; wavelength	
Attenuation and dispersion	
Terminations: reflection; standing waves; characteristic impedence	
Partial reflection; standing waves; superposition of incident & reflected waves	
nλ/2 lines: resonance & effect on it of attenuation; 1:1 impedance-transformation	
Lines with dissimilar lossless termination: resonance; capacitive detuning; reactive line impedance either side of resonance	



10 V pk-pk from 600 W - output impedance. Feedback's Variable Phase Generator VPG608 is ideal for this purpose.
For the impedance investigations in demonstration/assignments four and five, an X-Y oscilloscope with dc coupling and a long persistence tube is required.
The application notes suggest ways in which more detailed impedance measurements can be made with the help of resistance boxes, a capacitor and a micro meter.





Control settings
8L
Minimum attenuation
Step to A

Control settings
8L
Mid attenuation
Step to A

Control settings
2L
Minimum attenuation

Control settings
8L
Mid attenuation
Step to A

Control settings
L
Minimum attenuation

Control settings
L
Minimum attenuation

Specification

Display	LED columns indicating positive and negative voltages at 13 positions.
Propagation time	Switch 0.25, 0.5, 2 s at zero attenuation, representing line lengths L, 2L, 8L respectively.
Attenuation	Simulates attenuation due to the lines series resistance. Continuously variable.
Step input	A centre-stable 2-way switch applies a signal to either end of the line.
Line impedance	600Ω
Plug-in terminations	short-circuit link (2) 600Ω 200Ω 1.8 kΩ 50Ω 100 kΩ 100µF nominal (reversible electrolytic)
Hold	Signals on the line are held at the instant of switching.
Power supply	100 - 125V / 200 - 250V 50 / 60Hz. Fuse rating 315mA.
Dimensions & Weight	Width: 813mm (32in) Depth: 203mm (8in) Height: 178mm (7in) Weight: 4kg (8.8 lb)
Tender Specification	Transmission Line Demonstrator using a simulated line to demonstrate visually at low frequencies the high frequency characteristics of a transmission line. To include manual of practical demonstrations and assignments, covering all the important aspects of these characteristics. NATO No 6910-21-884-6145
Ordering Information	Transmission Line Demonstrator (without function generator) TLD511

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