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Printed in U.S.A.

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Instruction Manual
655510J

for

CFL 510 Time Domain Reflectometer (TDR)

Catalog No. 655510

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510 Township Line Road
Blue Bell, PA 19422

215/646-9200
1-800-336-5543
FAX: 215/643-2670
Cable: BIDDLE
Telex: 685-1045 JGBCO

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Read the entire manual before operating.
Antes de operar este producto lea este manual enteramente.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Section 1
Introduction

Receiving Instructions

Check the equipment received against the packing list to ensure that all materials are present. The shipping carton should contain:

CFL 510 instrument
3-ft test lead
six AA cells
Instruction Manual 655510J-M
nylon carrying case

Notify Biddle Instruments of any shortage. Telephone (215) 646-9200.

Examine the instrument for damage received in transit. If any damage is discovered, file a claim with the carrier at once and notify Biddle Instruments or its nearest authorized sales representative, giving a detailed description of the damage.

The instrument has been thoroughly tested and inspected to meet rigid specifications before being shipped. It is ready for use when set up as indicated in this manual.

General Information

The CFL 510 Time Domain Reflectometer (TDR) provides a visual indication of cable faults such as open circuits, short circuits, and bad connections up to 9500 ft (3 km). It is a hand-held instrument with a digital readout. Typical uses are cable fault location and cable length

measurement. The principle of operation is that a pulse transmitted into a cable is reflected by any imperfection along the cable. Both the transmitted pulse and the reflected pulse are shown on the instrument display. The position of the reflected pulse on the display is used to determine the distance to the cable imperfection. The speed at which the pulse travels down the cable is a fraction of the speed of light in a vacuum. This fraction is called the propagation factor and is dependent upon the type of dielectric (insulation) used in the cable. A list of common propagation factors is given in Section 4 of this manual. Typical displays are presented.

The unit takes approximately 10 s to initialize after switching on. Each control must be pressed for 1 s to effect the display. The instrument is supplied with six replaceable AA size batteries. To conserve battery power the instrument will automatically turn itself off if not used for 5 min.

Section 2
Safety

It should be understood that any use of electricity inherently involves some degree of safety hazard. While every effort has been made by the manufacturer to reduce the hazard, the user must assume responsibility for ensuring his or her own safety.

- Safety is the responsibility of the user.
- The purpose of the equipment is limited to use as described in this manual. Do not use the equipment or its accessories for any purpose other than specifically described.
- Do not connect the instrument or lead to energized cable. Confirm that the cable under test is not energized before connecting the instrument. Treat all conductors of high-voltage power cable as a potential electric shock hazard. There is always the possibility of voltages being induced on these conductors because of the proximity to energized high-voltage lines or equipment. Before making connection to the cable, make sure all temporary grounds are in place.
- Do not operate this instrument in an explosive atmosphere.
- Do not touch the circuit during a test.
- The test lead must be in good condition, clean and free from broken or cracked insulation.

- This instrument is only to be used by a suitably trained and competent person.

- Refer to IEEE 510-1983 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing."

The following warning notice is used in this manual where applicable.

WARNING

Warning, as used in this manual, is defined as a condition or practice which could result in personal injury or loss of life.

Section 3
Description

Specifications

Ranges: 300 ft (128 m), 1000 ft (320 m), 3000 ft (1024 m), 9500 ft (3200 m)

Resolution: 1.6 percent of range

Accuracy: 3.2 percent of range

Sensitivity: sufficient to identify clearly an open or short circuit at 9500 ft (3200 m) on 0.5 mm diameter (24 AWG) telephone pair

Transmitted pulse:

waveform: sine squared
amplitude: 1.2 V peak
width: selected with each range and approximately 10 percent of the displayed range

Propagation factor: set to 0.67 on switch-on and adjustable between 0.01 and 0.99

Input/output connector: banana sockets; 3/4 in. (19 mm) centers

Output impedance: 100 Ω

Power requirements: 7 to 9 V dc comprising six AA size batteries

Battery life: nickel-cadmium - 0.5 Ah (14 days at 1 h/day)
alkaline - 1.8 Ah (1.5 months at 1 h/day)
lithium-iron - 3.3 Ah (3 months at 1 h/day)

Dimensions: 9 x 4.5 x 1.7 in. (228 x 115 x 42 mm)

Weight: less than 2.2 lb (1 kg) including batteries

Environmental: IEC 68 for Field Portable Test Equipment
operating temperature range: -4 to 122°F (-20 to 50°C)
storage temperature range: -40 to 158°F (-40 to 70°C)

Display: 80 x 32 dot matrix graphic display

Controls and Connectors (see Figure 1)

Power on/off: push button, when pressed, turns the instrument on and off (recessed to prevent accidental activation).

Mode select: dual function push button selects the display, to change the propagation factor and to display the cable trace.

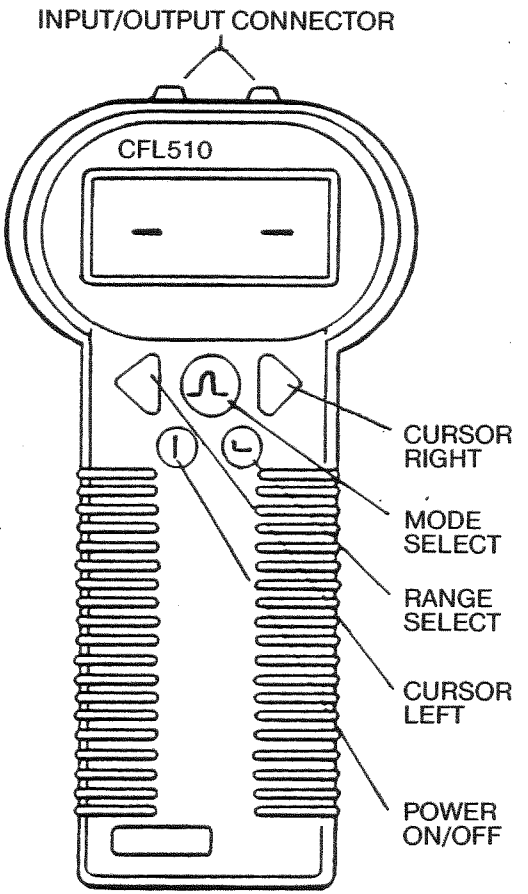

Figure 1: CFL510 Controls

Cursor controls: dual function push buttons move the cursor to the left and right and also change the propagation factor.

Range select: push button selects range in four increments by successive operation; the range selected is displayed in the bottom right-hand corner of the display.

Input/output connector: banana sockets provide connection to test lead.

Section 4
Operation

Battery Installation (see Figure 2)

1. Place instrument face down.

2. Unscrew two recessed screws securing the cover.

3. Lift off cover.

4. Install six AA size batteries, three in each of two plastic retaining tubes, according to the polarity markings indicated.

5. Replace cover and secure with retaining screws. Do not overtighten.

Batteries should be replaced when the display remains blank after switch on and when the battery low indicator (⊣⊢) is displayed.

Setting the Propagation Factor

Switch the instrument on. The propagation factor can only be set when the display is as shown in Figure 3 and is preset to 0.67, suitable for polyethylene dielectric. Other propagation factors are given in the following list. Consult the cable manufacturer for specific values.

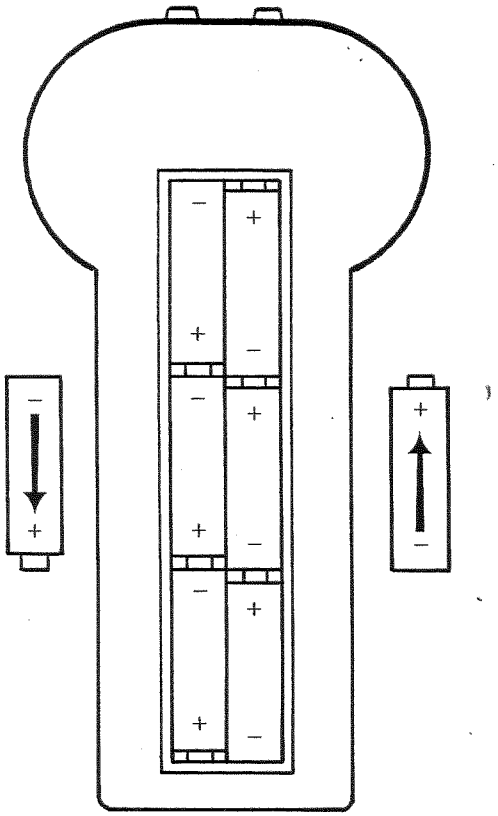

Figure 2: Battery Installation Diagram

Figure 3: Propagation Factor Display

Common Propagation Factors

Paper oil filled (PILC)	0.50 to 0.56
Cross-linked poly (XLPE)	0.52 to 0.58
Jelly filled poly	0.64
Polyethylene (PIC)	0.67
PTFE (Teflon®)	0.71
Paper (Pulp 0.083 µF/mile)	0.72
Paper (Pulp 0.972 µF/mile)	0.88
Foam poly	0.82
Air spaced coaxial	0.94
Air	0.98

To change the setting to suit any particular dielectric, use the cursor right and left controls to increase or decrease the propagation factor indicated.

When the mode select switch is pressed to obtain the cable trace, the selected propagation factor is stored and shown in the bottom left-hand corner of the display. To change the propagation factor again, press the mode select switch and use the right and left cursor controls to increase or decrease the propagation factor indicated until the desired factor is indicated. If the instrument is switched off, the stored propagation factor is lost and reverts to 0.67 when the instrument is switched on again.

Connecting to a Cable

Observe all safety precautions. Refer to Section 2, Safety.

WARNING

The cable under test is a possible source of high voltage. Before connecting the test leads, verify that the cable is de-energized and apply temporary ground connections using accepted industry techniques. Do not connect the instrument to an energized cable.

1. Insert the banana plug connector of the supplied test lead into the instrument input/output connector.

2. Connect each test lead alligator clip to one of the conductors in the cable. The instrument has a balanced output, so the polarity of the test leads does not matter. Figure 4 shows a diagram of the proper way to connect the instrument to a cable consisting of a twisted telephone pair. Figure 5 shows a cable trace. Remove the temporary ground connections before continuing.

3. Switch the instrument on and select the appropriate propagation factor for the cable dielectric.

4. Press the mode select control and obtain the cable trace. The instrument automatically selects the 9500 ft (3000 m) range.

5. Inspect the display for reflections which appear as upward or downward pulses.

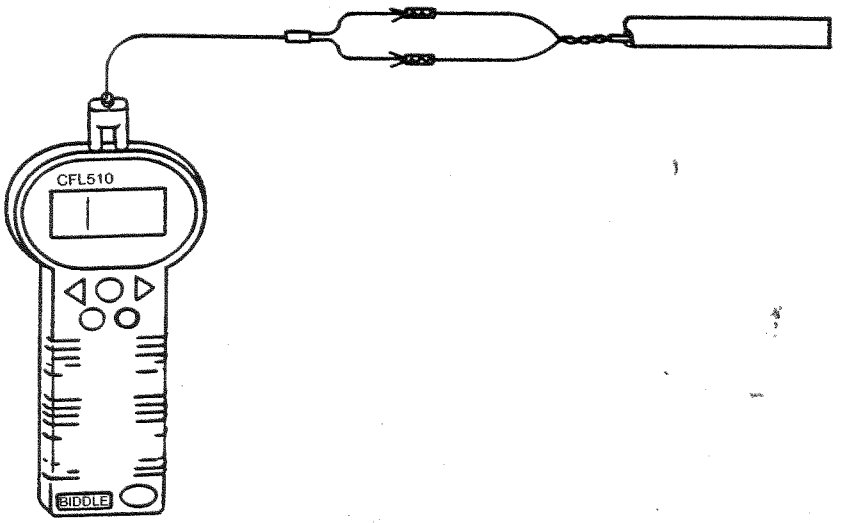

Figure 4: Connection Diagram

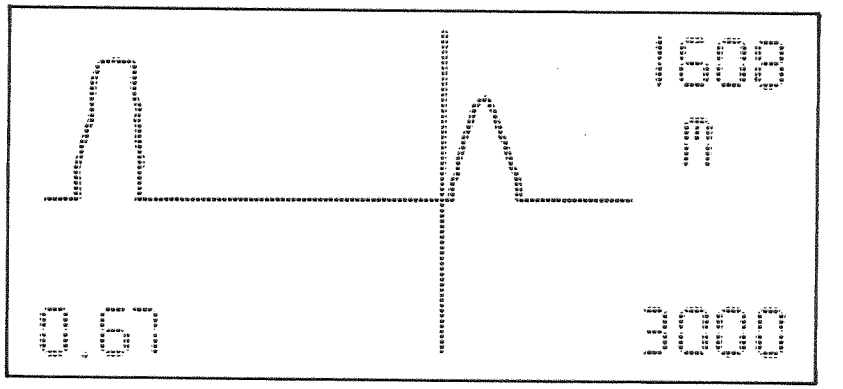

Figure 5: Cable Trace Display

If no reflection is observed the fault may be:

- Beyond the range of the instrument
- Beyond the sensitivity of the instrument
- Close to the instrument and obscured by the transmitted pulse.

Operation of the range select control will select in turn the 3000 ft (1000 m) range 3, 1000 ft (300 m) range 2, and 100 m (300 ft) range 1, and then 9500 ft (3000 m) range 4. Select the range which gives the greatest separation between transmitted and reflected pulses.

Determining Unknown Propagation Factors

If the cable dielectric is not known, the propagation factor can be determined by using a known length of the same type of cable or distance to a known point in the same cable.

1. Measure the apparent distance to the end or known point with the propagation factor set to 0.67 using the procedure described for Locating the Distance to Fault/Length Measurement.

2. Adjust the propagation factor as previously described until the distance to the end displayed agrees with the known distance or known point.

Locating the Distance to Fault/Length Measurement

Obtain the display using the preceding procedure. Figures 5, 6, and 7 show typical displays. Use the cursor controls to move the cursor left or right until the cursor coincides with the point on the horizontal line just before the reflected pulse from the fault or cable end. Reflected pulses appear as upward or downward deviations from the horizontal line.

The distance to the fault or length of the cable in feet is displayed in the top right-hand corner. On the longer ranges, noise may be present on the trace due to the high sensitivity of the instrument. Remember to deduct the length of the test lead, 3 ft (1 m), from the displayed distance.

Practical Examples

Open Conductors (see Figure 6)
The reflection has the same polarity (upwards) as the transmitted pulse.

High Resistance Joint/Splice (see Figure 6)
The reflection is similar to that for an open conductor, the amplitude being dependent upon the effective resistance of the joint.

Shorted Conductors (see Figure 7)
The reflection has the opposite polarity (downwards) to the transmitted pulse.

Low Insulation Resistance (see Figure 7)
The reflection is similar to that for shorted conductors, the amplitude being dependent upon the effective insulation resistance.

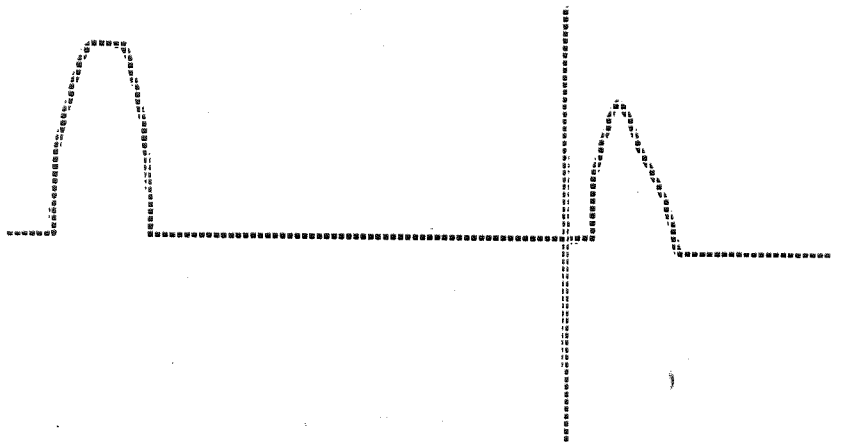

Figure 6: High Resistance Joint/Splice Display

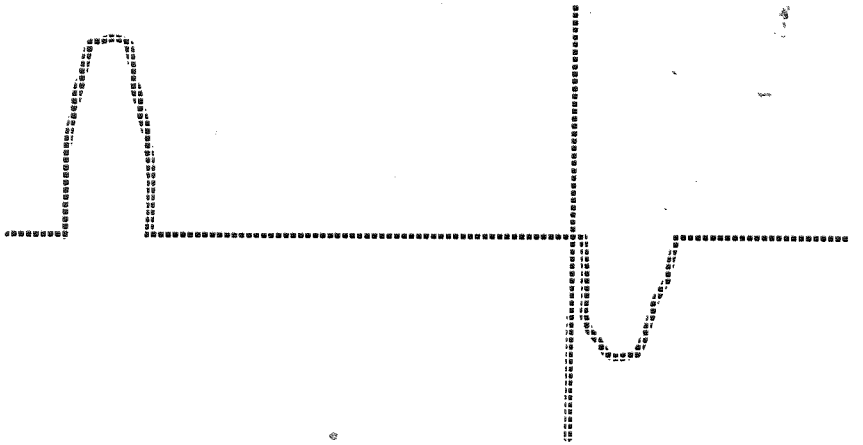

Figure 7: Low Resistance Fault Display

Section 5
Service

Maintenance

The exterior of the case can be cleaned by using a mild detergent and water and then drying with a clean dry cloth. Care should be taken to prevent the ingress of foreign material. The test lead should be inspected occasionally to ensure that it is in good condition. The instrument has no internal adjustments and requires no routine service or calibration.

Due to the compact nature of the instrument and the use of custom built elements and surface mounted components, it is recommended that the instrument be returned to the factory for repair or replacement if found to be defective in form or function. This instrument is not user serviceable other than the replacement of batteries. Refer to battery installation procedure, Section 4.

Repair

Biddle Instruments offers a complete repair service and recommends that its customers take advantage of this service in the event of any equipment malfunction. Please indicate all pertinent information, including problem symptoms. The serial number and catalog number of the instrument should also be specified. Equipment returned for repair must be shipped prepaid and insured and marked for the attention of the Repair Department.

Preparation for Shipment and Storage

Remove batteries before shipment or long term storage (more than 2 months). Place the instrument in its carrying case along with the test lead. Pack in a carton or box with adequate dunnage in accordance with best commercial practice (ASTM D 3951-82). Use original shipping carton if available. Seal container with waterproof tape. Store container in a clean dry place. Storage temperature should not exceed the range of -40 to 158°F (-40 to 70°C).

GLOSSARY

CFL	cable fault locator
IEC	International Electrotechnical Commission
PIC	polyethylene-insulated conductor
PILC	oil-filled paper
propagation factor	the ratio of the speed of an injected pulse traveling down a cable to the speed of light in a vacuum. This ratio is dependent upon the cable dielectric.
PTFE	polytetrafluoroethylene (Teflon®)
TDR	(time domain reflectometer) an instrument designed to measure characteristics of a transmission system connected to the instrument by monitoring pulsed signals entering the test object and the superimposed reflected signals on a display.
XLPE	cross-linked polyethylene

WARRANTY

Products supplied by Biddle Instruments are warranted against defects in material and workmanship for a period of one year following shipment. Our liability is specifically limited to replacing or repairing, at our option, defective equipment. Equipment returned to the factory for repair must be shipped prepaid and insured. This warranty does not include batteries, lamps, or other expendable items, where the original manufacturer's warranty shall apply. We make no other warranty. The warranty is void in the event of abuse (failure to follow recommended operating procedures) or failure by the customer to perform specific maintenance as indicated in this manual.

NOTES