OPERATORS MANUAL

MODEL

2901B +

DIGITAL TIME DOMAIN REFLECTOMETER

CABLE FAULT LOCATOR

RISER-BOND
INSTRUMENTS

9-87

TABLE OF CONTENTS

SECTION 1: PRODUCT SPECIFICATIONS

PHYSICAL DIMENSIONS:	Height: 3.25 inches (82.6mm) Width: 6.06 inches (153.9mm) Depth: 6.25 inches (158.8mm) Weight: 3 pounds (1.35kg)
POWER:	Four cell NiCad battery pack.
ENVIRONMENTAL:	Operating range -10°C (+14°F) to +55°C (+131°F). Storage range -30°C (-22°F) to +70°C (+158°F).
DISPLAY:	4½ digit Liquid Crystal Display with 0.4 inch characters, annunciators to indicate OPEN or SHORTed cable, low battery, powered cable, and readout in meters or feet.
DYNAMIC RANGE:	Better than 20dBRL in the least sensitive mode to better than 40dBRL in the most sensitive mode.
ACCURACY:	+/— 1% of reading
INPUT PROTECTION:	Up to 250 V.
RANGES:	SHORT CABLE: 15 nsec pulse out, at least 1100 feet or 199.9 meters readability, 15 feet or 4.6 meters minimum cable length. LONG CABLE: 100 nsec pulse out, at least 11,000 feet or 1999 meters readability, 100 feet or 33 meters minimum cable length.
VELOCITY OF PROPAGATION:	Thumbwheel switches adjustable from .99 to .01 in increments of .01.
OUTPUT CONNECTOR:	Front panel BNC.
RESOLUTION:	Short Cable Mode: 1 foot or .1 meter. Long Cable Mode: 10 foot or 1 meter.
OUTPUT SIGNAL REPETITION RATE:	Less than 0.5 msec.
STANDARD ACCESSORIES INCLUDED:	BNC to "F" adaptor; Probe; Battery charger; Manual; Ni-Cad batteries; Carrying case; BNC Tee; BNC to BNC Jumper.

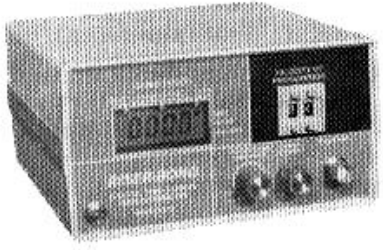
SECTION 2: FRONT PANEL DESCRIPTION

The RISER-BOND INSTRUMENTS MODEL 2901B+ is a radar type DIGITAL TIME DOMAIN REFLECTOMETER, CABLE FAULT LOCATOR.

The 2901B+ has three front panel controls:

- Velocity of Propagation Switch
- Cable Length Mode Switch
- ON/OFF Switch and Variable Return Loss Sensitivity Control

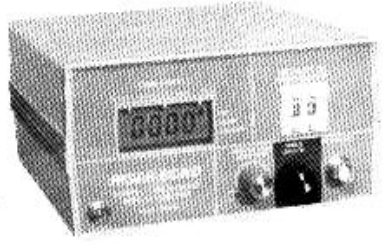
VELOCITY OF PROPAGATION SWITCH



The VELOCITY OF PROPAGATION switch is set to the type of cable that is under test. The number shown on the switch shows a velocity of propagation from .01 to .99. The velocity of propagation varies with each type of cable.

Because of the long list of cable types, it is not practical to list all of them here. You can obtain the particular numbers you need from your cable supplier's catalogs. A partial listing can be found on page 16.

CABLE LENGTH MODE SWITCH



The CABLE LENGTH MODE SWITCH has two positions. The SHORT CABLE mode and the LONG CABLE mode.

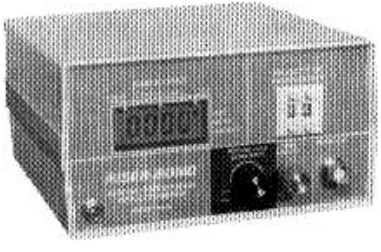
In the SHORT CABLE mode, the 2901B+ will read a maximum distance of 1100 feet with one foot of resolution or 199.9 meters with 0.1 meter of resolution. The minimum length of cable that can be tested or measured is 15 feet or 4.6 meters.

In the LONG CABLE mode, the 2901B+ will read out to its maximum capability of 11,000 feet with ten feet of resolution or 1999 meters with 1 meter of resolution. The minimum length of cable that can be tested or measured is 100 feet or 33 meters.

Although the 2901B+ cannot find faults in the first 15 feet (4.6 meters) of cable in the SHORT CABLE mode and the first one hundred feet (33 meters) in the LONG CABLE mode, DO NOT ADD THESE FOOTAGES TO THE DISPLAY READING. The 2901B+ takes this into consideration.

The 2901B+ can read a maximum distance of 11,000 feet (1,999 meters). However, different types of cable have different loss factors at high frequency and consequently have a shorter maximum readability.

ON/OFF SWITCH AND RETURN LOSS SENSITIVITY CONTROL



The 2901B+ has a combined rotary type ON/OFF SWITCH and VARIABLE RETURN LOSS SENSITIVITY control.

The instrument is OFF when the VARIABLE RETURN LOSS SENSITIVITY control is turned full counterclockwise past the click stop.

To turn the instrument ON, simply rotate the RETURN LOSS SENSITIVITY control clockwise until you feel a click.

The VARIABLE RETURN LOSS SENSITIVITY control can be adjusted from 20 dBRL in the least sensitive mode to 40 dBRL in the most sensitive mode.

The 2901B+ features an auto-zero function. If a fault is contained within the first 15 feet in the SHORT CABLE mode or within the first one hundred feet in the LONG CABLE mode, or if no cable is attached to the front panel BNC, the instrument will display an all zero reading.

CHARGING THE INSTRUMENT

Charging the instrument (cont.)

The 2901B+ is powered by a four cell rechargeable NiCad battery pack, contained within the instrument.

To recharge the battery pack, simply plug the external battery charger into the 2901B+ front panel charger input and into any common 110 VAC outlet.

The 2901B+ features a LOW BATTERY INDICATOR. When the batteries need charging, an LCD ANNUNCIATOR will appear on the front panel display.

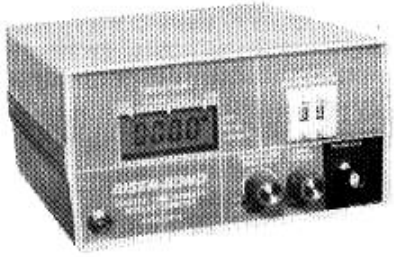
The 2901B+ will operate for approximately 6 hours between charges. The NiCad battery pack will last longer if it is discharged before it is recharged. Allow at least 16 hours charging time for the batteries.

The 2901B+ can be charged using the 110 VAC to 12 VAC charger or a 12 volt automobile battery system (DC auto charger is not included).

The sleeve of the charger input is the negative input and the tip (inside sleeve) is the positive input. The 2901B+ charging circuit is diode protected so no damage will occur if connected wrong, but the instrument will not charge.

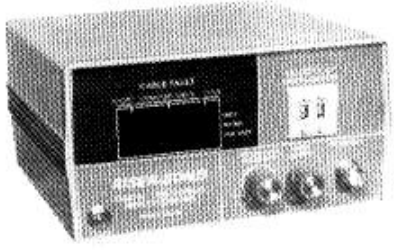
The 2901B+ has a built-in current limiting circuit and will absorb a constant 350 ma.

OUTPUT CONNECTOR



The front panel contains a BNC connector, which is to be connected to the cable under test. A BNC to "F" fitting, a BNC to Alligator Clips Probe (both included) or an Entrance to "F" fitting and splice block allow easy connection to various size coax cables.

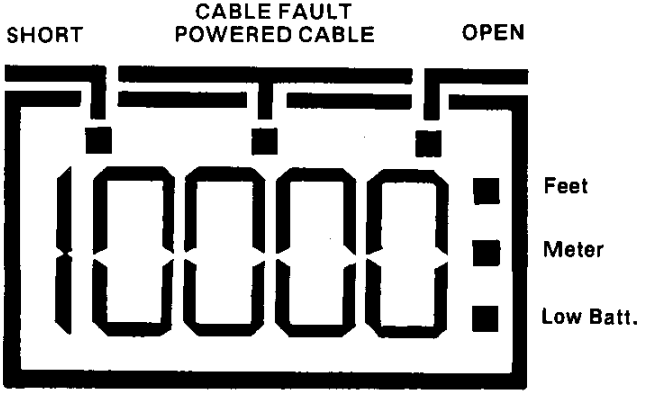
LIQUID CRYSTAL DISPLAY



The LCD contains five, 0.4 inch digits. Four digits are displayed in the SHORT CABLE mode. All five digits are displayed in the LONG CABLE mode.

In addition to the five digits, the display also contains six LCD ANNUNCIATORS, which illuminate, showing certain conditions exist. These ANNUNCIATORS indicate:

- CABLE FAULTS (OPEN AND SHORT)
- POWERED CABLE WARNING
- FEET OR METERS
- LOW BATTERY WARNING



FAULT LOCATOR

The RISER-BOND INSTRUMENTS MODEL 2901B+ DIGITAL TDR is used to test transmission cable for OPENS, SHORTS, and MAJOR IMPEDANCE DISCONTINUITIES.

CAUTION: Care must be taken that the 2901B+ NOT be connected to cable that has a signal or power present. No instrument damage will occur, but you may get an erroneous reading.

The 2901B+ features a POWERED CABLE WARNING INDICATOR which will illuminate if a signal or power is present on the cable under test.

Connect the cable to be tested to the 2901B+ front panel BNC. Turn the instrument power switch on and the sensitivity control full counterclockwise to the least sensitive mode.

From cable manufacturer data, determine the velocity of propagation of the cable and dial this into the VELOCITY OF PROPAGATION thumbwheel switches.

Different types of cable have different loss factors at high frequency. Some common cable types and the maximum cable length the 2901B+ will test are listed on page 10.

OSCILLOSCOPE OUTPUT CAPABILITY

The 2901B+ features "oscilloscope output capability". In addition to its digital readout, the model 2901B+ can be connected to an oscilloscope allowing the operator to look at the transmitted and reflected signal waveform of the cable under test.

This feature of the model 2901B+ affords the operator a choice between using the instrument by itself and thereby maintaining the simplicity of one-button-operation, or connecting an oscilloscope to the 2901B+ for greater flexibility, sensitivity, and an actual view of the waveform of the cable under test.

To see the waveform of the cable under test, you will need an oscilloscope with a bandwidth of at least 50 MHz (an oscilloscope with a bandwidth of less than 50 MHz may be used, but the display intensity or brightness may be significantly reduced).

Referring to Fig. 3-1, connect the BNC Tee to the scope VERTICAL INPUT. Connect the short BNC to BNC jumper cable from the 2901B+ front panel BNC to one side of the BNC Tee. Connect the cable to be tested to the other side of the BNC Tee.

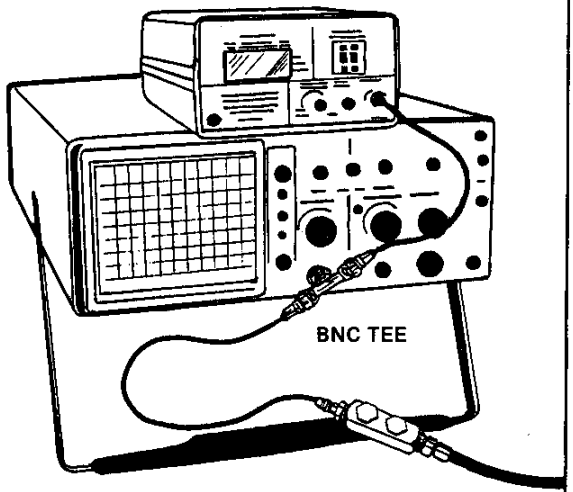


Fig. 3-1

For an Initial waveform and using an example of a 1000 foot piece of cable as the cable under test, set the 2901B + to the LONG CABLE MODE and set the scope functions as follows:

Vertical Attenuation	2 volts/div.
Vertical Coupling	DC
Timebase	0.5 usec/div.
Triggering	Internal
Triggering slope	Rising Edge

Set the scope trigger level control to trigger on the peak of the rising edge of the transmitted pulse.

These settings will allow you to look at a 1000 foot piece of cable. To look at longer or shorter lengths, simply change the scope timebase setting. You want to have the transmitted pulse and the first reflection displayed on the scope screen.

To see more horizontal detail, switch the scope timebase to the 10X mode and use the HORIZONTAL POSITION CONTROL to move the viewing window from left to right while retaining the whole span of the waveform from the transmitted pulse to the reflection (Fig. 3-2).

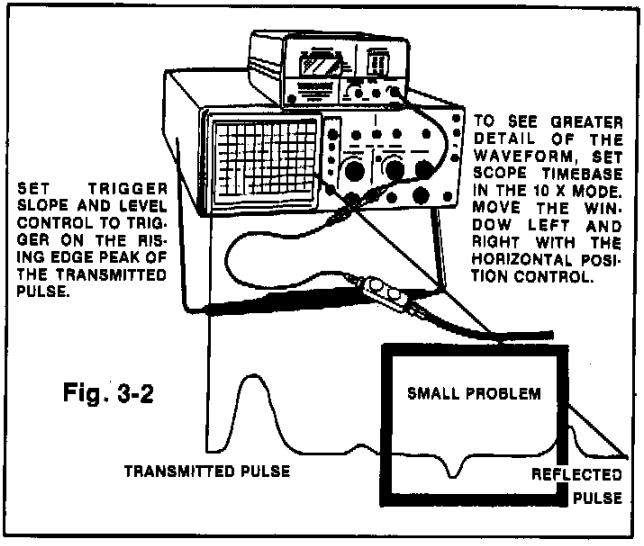


Fig. 3-2

To look at smaller problems on the cable, simply change the scope VERTICAL ATTENUATION setting.

Once you have a waveform on the screen of the scope, you can change the 2901B+ to the SHORT CABLE MODE, or change the scope to various settings to see the details of the cable waveform.

NOTE: When changing the 2901B+ from the LONG to SHORT cable mode, or from the SHORT to the LONG cable mode, you may need to readjust the scope trigger level control.

The 2901B+ will read out the footage to the first major discontinuity. If there are smaller problems in front of the larger problem, the 2901B+ sensitivity control can be rotated clockwise to increase the sensitivity and locate the problem. If the problem is too slight for the 2901B+ to detect, but still shows on the CRT display of the oscilloscope, you will have to calculate the distance to the minor fault.

Remember, the 2901B+ is calculating the distance to a problem from its front panel. When measuring to the problem, you will need to account for the short jumper between the 2901B+ and the scope.

WHAT CAN THE OSCILLOSCOPE SHOW ME?

Let us look at an actual waveform. Referring to Fig. 3-3, we can see the transmitted pulse (Point A), the reflected pulse (Point D - the end of the cable) and two other reflections of less severity (Points B and C).

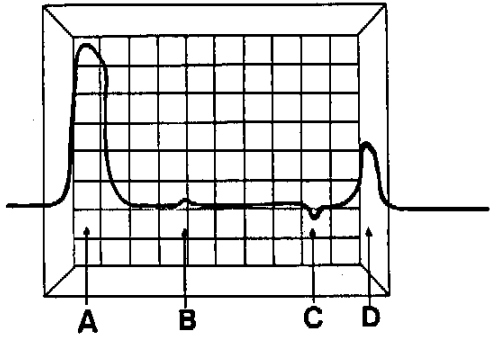
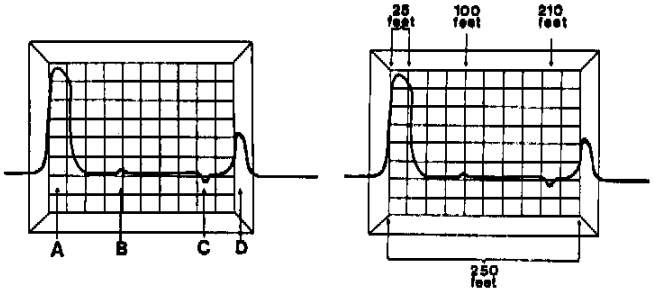


Fig. 3-3

When testing this particular cable in the least sensitive mode, we get a digital reading of 250' (Points A-D, the full length of the cable). As we increase the sensitivity control (clockwise), the 2901B + Digital Readout indicates a SHORT at 210' (Points A-C). As we adjust the VARIABLE SENSITIVITY CONTROL full clockwise to the most sensitive mode, we find that the Digital Readout remains on Point C. The 2901B + alone is not sensitive enough to trigger on Point B. However, because we can see this discontinuity on the oscilloscope, we can closely estimate this fault to be 100' from our test point (see Fig. 3-4).



IF IT IS 250 FEET FROM THE RISING EDGE OF POINT A TO THE RISING EDGE OF POINT D, THEN EACH OF THE TEN DIVISIONS IS EQUAL TO 25 FEET. POINT B IS THEREFORE 100 FEET FROM POINT A.

Fig. 3-4

Upon close examination of this cable, we found that Point D was the end of the cable. Point C was a cracked jacket which allowed deterioration of the sheath, causing enough reflection to be detected by the 2901B + .

Point B turned out to be a splice in the cable. This was a good splice. Although undetectable by the 2901B + , the splice could still be seen on the oscilloscope. The 2901B + is not sensitive enough to detect a good splice (if it were, it could prove to be counterproductive. You do not want to be digging up good splices).

The KEY POINT: With the oscilloscope attached to the 2901B + , you can identify even the smallest discontinuity (cable fault) in your cable and its approximate distance from your test point. Caution: Do not start chasing problems that are too small to worry about.

MAXIMUM TESTABLE CABLE LENGTH

CABLE	LONG MODE		SHORT MODE	
	Feet	Meters	Feet	Meters
COAXIAL				
412 OR LARGER	11,000	1999	1100	199.9
RG-59	2,800	850	1100	199.9
TWISTED PAIR				
19 AWG	6000	1800	1100	199.9
22 AWG	4000	1200	1100	199.9
24 AWG	3000	900	1000	199.9
26 AWG	1500	450	600	180.0

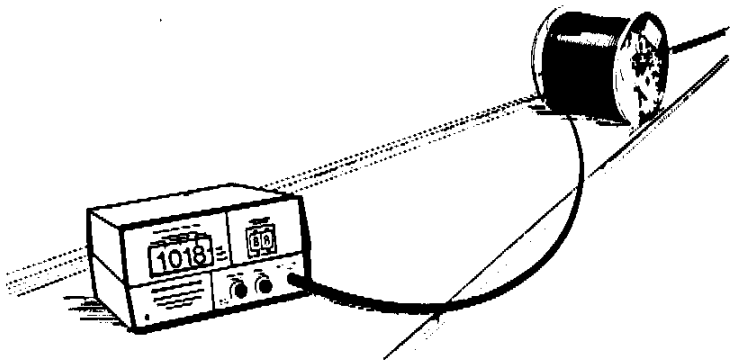
When testing a piece of cable for a fault, always switch the TDR to the SHORT CABLE mode first, since you are not certain if the fault is contained within the first 1100 feet (199.9 meters) or beyond 1100 feet (199.9 meters).

Look at the LIQUID CRYSTAL DISPLAY. If you get a reading of under 1100 feet and the ANNUNCIATOR indicates an OPEN or a SHORT fault, then you have located the fault and need only go the indicated distance and correct the problem. However, if neither OPEN or SHORT ANNUNCIATOR illuminates, slowly turn the RETURN LOSS SENSITIVITY control clockwise until the OPEN or SHORT ANNUNCIATOR appears. If you still do not get an indication, switch to the LONG CABLE mode and repeat the process. When the OPEN or SHORT ANNUNCIATOR appears and you get a digital reading, you have located the problem.

If a fault is located beyond 1100 feet while in the SHORT CABLE mode, the display will auto zero. If testing in meters, a reading of 199.9 meters should be checked against a LONG CABLE reading.

If, after switching to the LONG CABLE mode, you still do not get an indication of an OPEN or SHORT, the fault may be contained within the first 15 feet (4.6 meters) of cable. Since the TDR cannot directly read this first 15 feet, the problem can be alleviated by adding a 15 foot jumper to the cable under test at the point of connection. (Refer to HELPFUL HINTS section for additional information regarding fault location.)

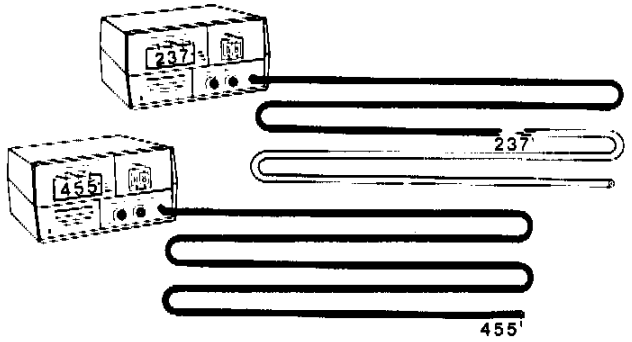
CABLE LENGTH MEASUREMENT



Although fault location is the 2901B+'s primary function, some other applications are also very useful. Measuring cable can be a helpful and money saving function of the 2901B+. Partial reels of cable discarded in the warehouse due to unknown quantities now become useful stock by determining their approximate lengths right on the reel. The 2901B+ can also instantly check the lengths of incoming new stock for any breaks or shortages.

NOTE: When using your TDR for cable length measurement, measure the cable in the MOST SENSITIVE MODE (40dBRL). When measuring or testing COILED cable, there may be as much as a 2% error introduced.

SECTION 4: THEORY OF OPERATION



The 2901B+ Digital TDR is a radar type cable fault locator. It transmits a pulse, which travels down the cable until reaching either a fault or the end of the cable. The signal is then reflected up the cable to the TDR and the transit time is measured, converted to feet or meters and displayed on the front panel LCD.

DO NOT TERMINATE THE CABLE

Because a TDR works on the radar principle, you want to make sure that the cable under test is NOT terminated. A terminator may absorb the TDR's pulse and therefore no signal will return resulting in an all zero reading. It is best if both ends of the cable have been disconnected from all equipment.

If the cable is damaged or not terminated, some or all of the signal will be reflected back up the cable. The amount of signal reflected is a function of how bad the mismatch is. The two extremes of a misterminated cable are an OPEN and a SHORT.

An OPEN or a SHORT will reflect all of the signal energy back up the cable. An OPEN will reflect the signal IN PHASE. A SHORT will reflect the signal OUT OF PHASE. The 2901B+ has the ability to tell the difference between an OPEN or a SHORT and will display this information on the front panel LCD.

Light travels in a vacuum at 186,000 miles per second. All other signals are slower. The speed a signal travels down a cable is called the VELOCITY OF PROPAGATION. A cable with a VELOCITY OF PROPAGATION of 1.00 would transmit a signal at the speed of light. Most cables have a VELOCITY OF PROPAGATION of between .61 and .95.

Cable is also lossy. The signal is attenuated as it travels along the cable. Different types of cable have different loss factors or signal attenuation per foot.

The difference between the amplitude of the transmitted pulse, the sensitivity of the RETURN PULSE DETECTOR, and the loss factor of the cable, determines the maximum length of cable that can be tested.

SECTION 5: INTEGRAL COMPONENTS

With this background information let us look at the component parts of the 2901B+ (refer to Fig. 5-1).

The PULSE GENERATOR circuits generate a pulse which is transmitted down the cable under test by way of the front panel BNC. At the same time the pulse is transmitted, the TIME TO VOLTAGE circuits start charging a capacitor. The fine charging rate of this capacitor is determined by the front panel VELOCITY OF PROPAGATION thumbwheel switches.

When the transmitted pulse sees a fault, it is reflected back to the RETURN PULSE DETECTOR circuit. This circuit stops the TIME TO VOLTAGE CONVERTOR and, depending on the polarity of the returned pulse, lights one of the front panel LCD ANNUNCIATORS. A positive going pulse would indicate an OPEN and a negative going pulse would indicate a SHORT.

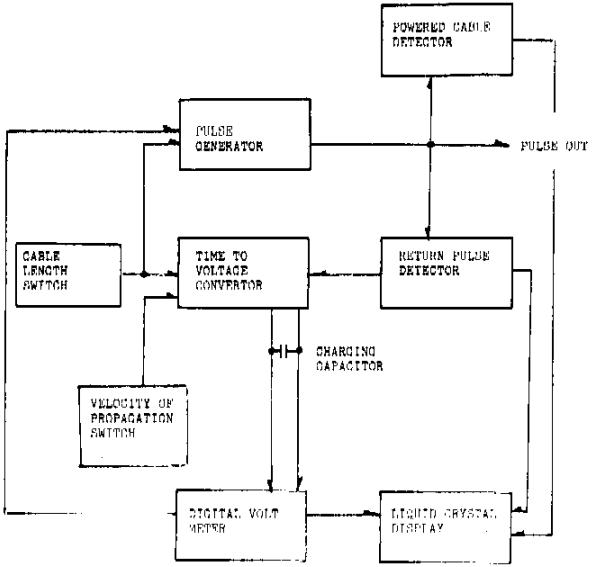
The DIGITAL VOLTMETER measures the voltage across the charged capacitor and displays it on the front panel LCD. The displayed voltage is calibrated in feet or meters.

When the DVM has completed its conversion cycle it restarts the PULSE GENERATOR thus starting a whole new cycle.

The transmitted pulse width and the course rate of charge across the capacitor are determined by the front panel CABLE LENGTH switch.

The VARIABLE RETURN LOSS SENSITIVITY control adjusts the sensitivity of the RETURN PULSE DETECTOR from approximately 20 dBRL to 40dBRL.

FIG. 5-1 BLOCK DIAGRAM



FEET TO METERS CONVERSION

The LCD readout of the 2901B+ can be calibrated for either feet or meters.

To change the readout of the 2901B+ from feet to meters or from meters to feet, move the jumpers on the circuit boards.

These jumpers can be easily removed and placed in a configuration for digital readout in meters (see Fig. 6-1) or in feet (see Fig. 6-2) on page 14.

NOTE: When changing from feet to meters or from meters to feet, the 2901B+ may need to be re-calibrated.

Maximum readability in the SHORT CABLE mode is at least 1100 FEET or 199.9 METERS.

Maximum readability in the LONG CABLE mode is at least 11,000 FEET or 1999 METERS.

FIG. 6-1 METER JUMPER CONFIGURATION

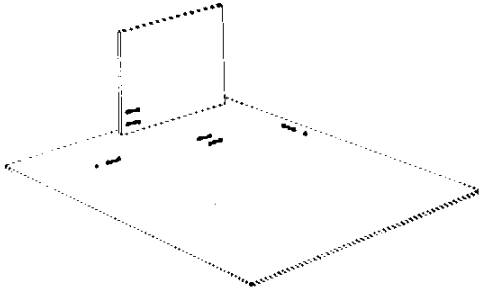
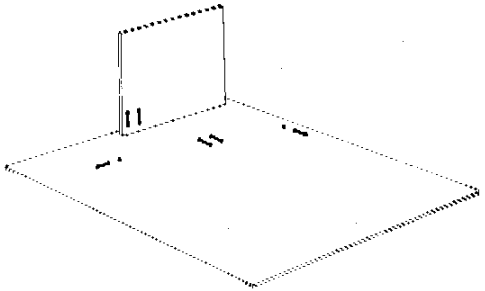


FIG. 6-2 FEET JUMPER CONFIGURATION



CALIBRATION

Your MODEL 2901B+ comes pre-calibrated from RISER-BOND INSTRUMENTS.

The 2901B+ should give you years of trouble-free operation without periodic calibration. However, your instrument may need to be re-calibrated whenever the readout is changed from FEET to METERS or vice-versa.

Should you feel it necessary to calibrate your instrument, remove the top half of the case and set it aside.

Make sure the batteries are fully charged and in good condition. The 1.25 volt batteries are in a series string and should have a total of at least 4.6 volts.

NOTE: When using measured lengths of cable for your calibration procedure, it is recommended that the cable be laid out in a straight line. There may be as much as a 2% error when measuring cable that is coiled.

1. Dial in the VELOCITY OF PROPAGATION of the cable under test on the front panel VELOCITY OF PROPAGATION thumbwheel switches.

2. Set the CABLE LENGTH switch to the LONG CABLE mode.

3. Turn on the 2901B + and allow a warm up period of at least 5 minutes.

4. Set the LONG CABLE pot and the SHORT CABLE pot to mid-range.

5. Connect a measured 200 foot piece of cable with a known velocity of propagation to the PULSE OUT front panel BNC connector. Dial this number into the velocity of propagation thumbwheel switch. Adjust the OFFSET pot for the proper reading on the display (see Fig. 6-3).

6. Replace this cable with a similar type measured cable of 2,000 to 4,000 feet and adjust the LONG CABLE pot for the proper reading.

7. These two pots are interactive. Repeat steps 5 and 6 until you get the proper readings for both cables.

8. Select another measured cable between 300 and 500 feet in length with a known velocity of propagation and connect it to the front panel BNC connector. Set the front panel CABLE LENGTH switch to the SHORT CABLE mode and adjust the SHORT CABLE pot for the proper cable length reading.

This completes the calibration of the 2901B + . Reassemble the two half shells and replace the two screws.

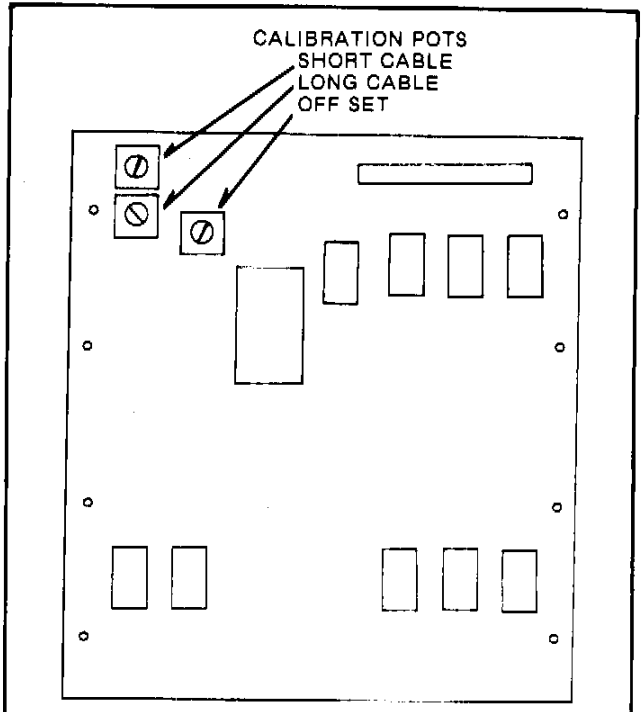


FIG. 6-3

SECTION 7: HELPFUL HINTS

As with any new piece of test equipment, getting to know the instrument and the proper testing procedures will result in greater accuracy and respect for its use. The following HELPFUL HINTS will enable you to better utilize your new equipment.

VELOCITY OF PROPAGATION

Having the correct velocity of propagation is the most important factor in the fault finding process.

Cable Dielectric varies from one manufacturer to another, from one manufacturing run to another, and with temperature (approximately 1% for every 10 degrees centigrade of change). With this change in dielectric constant, so changes the velocity of propagation and thus, the apparent length of the cable.

If you do not know the velocity of propagation number for a particular type of cable, the velocity of propagation can be determined. Measure a length of cable identical to the type you wish to test. The longer the cable tested, the more accurate the reading. Connect it to the front panel BNC. Look at the display reading. Change the thumbwheel setting on the VELOCITY OF PROPAGATION switch until the LCD reading matches that of the known cable length. You have now determined the approximate velocity of propagation setting.

VELOCITY OF PROPAGATION
A partial listing of cable types

Manufacturer	Family	VOP
COAXIAL CABLE		
BELDEN	DROP Foam	.78
	Solid	.66
CAPSCAN	DROP	.82
	CC	.88
COMM SCOPE	DROP	.82
	PARA I	.82
	PARA III	.87
	Q R	.88
GENERAL CABLE	DROP	.82
	MC2	.93
SCIENTIFIC ATLANTA	DROP	.81
	CABLE FLEX	.87
TIME FIBER	DROP	.83
	T 4	.88
	TR +	.87
TWISTED PAIR		
	PIC	.67
	JELLY FILLED	.64
	PULP	.72
POWER CABLE		
	2 CONDUCTOR	.68
COMPUTER/ INSTRUMENTATION		
	POLYETHYLENE	.66
	POLYVINYL CHLORIDE	.45
BELDEN	53 ohm	.70
	73 ohm	.70
	93 ohm	.85
	TWIN AXIAL	.71

FAULT FINDING

There are several ways to find the exact location of a fault in a length of cable by "normalizing out" the variation in the velocity of propagation.

If you are testing a piece of cable between two pedestals, use a cable locator to mark the exact route of the cable; then measure it with a measuring wheel. Remember to add extra feet for cable depth.

The use of a cable locator and measuring wheel are helpful in finding and marking buried cable.

Change the thumbwheel switches until the total distance of both tests equal the total length of the cable under test.

Next, using the 2901B+, test the cable from both ends. Change the front panel thumbwheels until the total distance of both tests equal the cable measured.

Now you have "normalized out" all the variables and have the exact location of the fault.

Each time the VELOCITY OF PROPAGATION switch is changed, be sure to test both ends of the cable before the next change. This procedure does assume only one fault per cable length. If there are gross changes in the thumbwheel settings, you may have multiple faults or the cable route may be wrong.

REMEMBER,
WHENEVER POSSIBLE, TEST THE CABLE FROM BOTH ENDS AND RECORD THE READINGS. CHANGE THE VELOCITY OF PROPAGATION THUMBWHEEL SETTINGS AND RE-TEST EACH END OF THE CABLE. REPEAT THIS PROCESS UNTIL BOTH READINGS EQUAL THE KNOWN LENGTH OF THE CABLE. YOU HAVE NOW PINPOINTED THE FAULT.

BLIND SPOTS

The 2901B + transmits a pulse, then waits for a reflection. This pulse has a finite width and the 2901B + cannot detect a fault while it is transmitting this pulse.

A cable fault can occur within a few feet of its end, too close for the 2901B + to detect. When you test from one end you get a reading that indicates the whole cable is good. When you test from the other end you get an all zero reading or a random reading and neither OPEN or SHORT ANNUNCIATOR illuminates. This indicates that a fault may be contained within the first 15 feet of cable, too close for the 2901B + to detect. The following procedure can eliminate this problem.

CABLE CHECK

A way to check to see if the whole piece of cable is good is to have someone alternately open and short one end of the cable while you test from the other end. If the OPEN or SHORT LCD's alternately illuminate, the cable is good or at least not damaged severely enough for the 2901B + to detect. If they do not, the cable is bad and the instrument should show a distance on the display panel and indicate an OPEN or SHORT. If an OPEN or SHORT is not indicated, the fault is probably too close to the end of the cable

Alternately open and short one end of the cable.

From the opposite end of the cable, watch for alternately lit OPEN-SHORT indicators.

to detect. In this case add a 15 or twenty foot piece of cable between the 2901B + and the cable under test. If you have to mix in a short length of cable with a different velocity of propagation, the error introduced is very slight.

The use of a jumper between the cable under test and your instrument can solve the problem of a fault within the first 15 ft. of the cable.

If you are testing a section where two different types of cable are mixed together, you will want to use a velocity of propagation that is between that of the two cables in question.

The TDR uses two and only two conductors to test a cable. If you are testing simple coax or a twisted pair the choice of connections is simple. If, however, you are testing tri-ax, multi-lead power cable, multi-lead twisted pair or flat ribbon cable, then the choice of connections becomes much greater. Remember . . . just choose two conductors at a time (try to choose two conductors that are close together). When testing the sheath of a multi-paired cable, you will need to use a different velocity of propagation than that used for the simple twisted pair.

The 2901B + will find any direct OPEN or SHORT. It will also find some partial faults. Whether it will or will not find a fault depends upon how bad the fault is and how close you are to it.

CABLE IS LOSSY. IT IS FOR THIS REASON THAT SOME FAULTS AT GREAT DISTANCES CANNOT BE DETECTED (THE AMOUNT OF RETURN LOSS REFLECTED IS REDUCED BY THE LOSS OF THE CABLE). TESTING THE CABLE FROM THE OPPOSITE END MAY YIELD DIFFERENT RESULTS.

CABLE CONNECTION

Various types of cable can be tested with the 2901B+. There are also several ways that connection can be made.

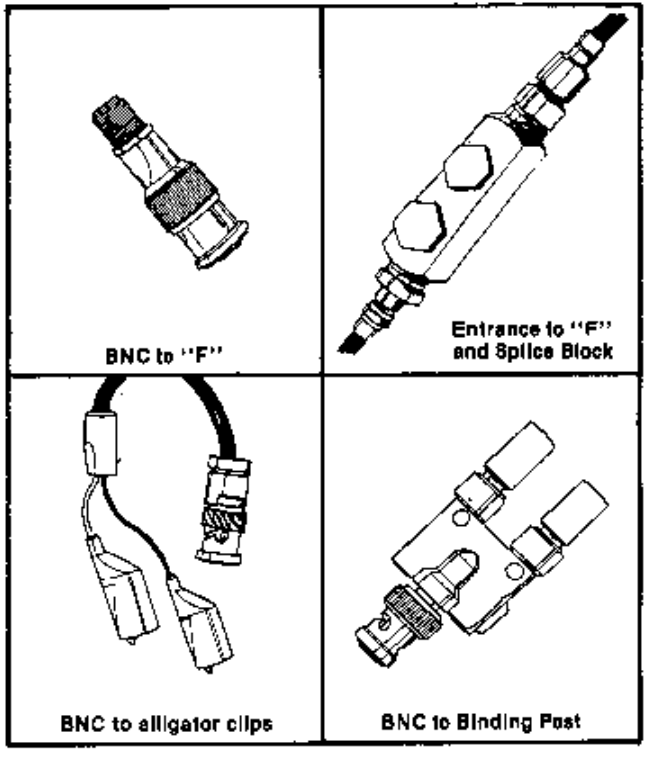
For coaxial cable, connect the cable to the front panel BNC. A BNC to "F" fitting is included with your instrument. However, you may need to obtain other adaptors for various size cables. An entrance to "F" fitting and Splice Block allow easy connection to various size cables.

For twisted pair or any multi-conductor cable, either connect a pair to the front panel, using the BNC to alligator clips probe or you can connect a conductor and the sheath to the front panel BNC, again using the BNC to alligator clips probe. A BNC to Binding Post adaptor (not included) may also be used for twisted pair.

A GOOD QUALITY CONNECTION BETWEEN THE INSTRUMENT AND THE CABLE UNDER TEST IS VERY IMPORTANT.

Any type metallic paired cable can be tested by your 2901B+. Cable in conduits, behind walls, and aerial or underground cable can all be tested with equal success.

CABLE CONNECTORS



DIRECT CONNECTION

The importance of a good quality connection between the instrument and the cable under test cannot be overstated.

EXAMPLE:

If you have cable with severe damage, you would expect to be able to locate the problem simply by connecting the BNC to Alligator Clips Probe to the cable (see Fig. 7-1).

If you were to test this cable with a scope type TDR, the resulting picture would show this resulting waveform (see Fig. 7-2). The damage cannot clearly be spotted due to the reflections caused by the mismatch of the probe at the connection. By replacing the probe with a Half-Inch connector into a Splice Block into an Entrance to F connector with a short piece of RG-59 to the TDR (see Fig. 7-3), a closed cable 75 Ohm environment is maintained and the damage is now easily located (see Fig. 7-4).

Many times the probe will work fine when trying to find a problem with a TDR. However, if you suspect the problem is a slight discontinuity or to improve the readability of your TDR, take the time to make a good connection between the TDR and the cable. It will be time well spent.

FIGURE 7-1

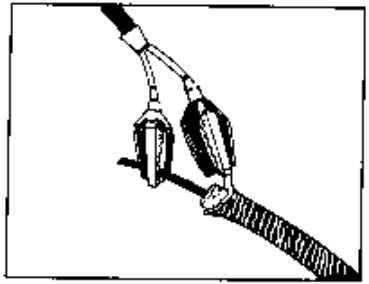


FIGURE 7-2

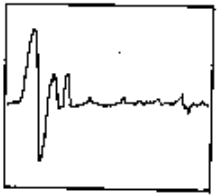


FIGURE 7-3

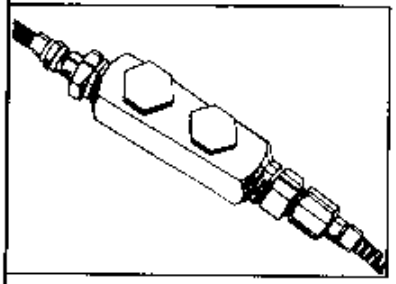
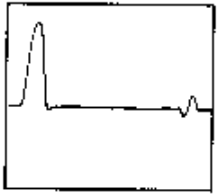


FIGURE 7-4



WARRANTY

RISER-BOND INSTRUMENTS warrants for a period of 1 year from the date of shipment from RISER-BOND INSTRUMENTS plant or its designated distributor, that the DIGITAL TIME DOMAIN REFLECTOMETER, MODEL 2901B+, shall be free from defects in material and workmanship which may develop under normal use in accordance with RISER-BOND INSTRUMENTS operating instructions.

Items returned for repair or replacement shall be shipped, along with a copy of the dated invoice, freight charges pre-paid, to the following address:

RISER-BOND INSTRUMENTS
5101 N. 57th Street
Lincoln, Nebraska
68507-9900
402-466-0933; FAX 402-466-0967

This warranty will be void if the items manufactured by RISER-BOND INSTRUMENTS are modified by the Purchaser during the period of warranty without RISER-BOND INSTRUMENTS written consent. This warranty is expressly made in lieu of all other warranties expressed or implied, including merchantability, whether arising by law, custom or conduct, and the rights or remedies provided herein are exclusive in lieu of any other rights or remedies unless specifically stated in the purchase order for this equipment. This warranty covers repair or replacement of the purchased item only and does not cover any subsidiary damages to associated customer equipment.

SERIAL# _____ (The serial number can be found on the shipping carton, on the back panel, and on the inside of the instrument.)

DATE OF PURCHASE _____