3.1 PURPOSE

Before installation of a new R.I.O. network, it is recommended that you check all cables and connectors for integrity, i.e., make sure they have successfully passed R.I.O. transmission. A visual inspection of the cable run should be made to ensure that the cable does not have sharp bends which are inside the minimun bend radius of the cable according to the manufacturer's specification. There should be bends in the cable to allow for strain relief of taps, splitters, and splices, and to reduce impedance changes due to temperature variations stretching the cable. Cable should not be run next to voltage sources which could induce psuedo data on the network. A general rule of thumb is 12 to 14 inches of separation distance per kilovolt.

3.2 TEST EQUIPMENT REQUIRED

A. Digital Multimeter.

B. **Baseband (1.544 MHz) Test Generator (Modicon P.N. LMT-1544) and Receiver (Modicon P.N. LMR-1544) or** frequent generator and voltage selective meter.

C. Time Domain Reflectometer (with printer).

D. Oscilloscope.

3.3 PROCEDURES

Network testing should be done without any interface devices connected. Taps installed for future expansion, but unused, should be terminated with a 75 ohm terminator.

3.3.1 Induced 60 Hz Voltage Check

Using an oscilloscope, measure (at the access point) the A/C voltage between the cable center conductor and ground. This voltage should be less than 30 m volts p/p. Repeat for all ports on the splitter.

Measured voltages higher than specification indicate an erroneous installation or poorly grounded cable. This should be cleared before the next tests.

NOTE

No test equipment (except an oscilloscope) should ever be connected to the coaxial cable if a 60 Hz voltage is present on the network.

3.3.2 Network Integrity Check

Ensure that the network does not contain any discontinuities which would degrade system performance.

Procedure

Using the 1503 TDR cable tester, set up in accordance with the operating procedure (see Appendix A), and measure the return loss of all detectable discontinuities along the trunk cable only. This is done by using the "Sensitivity" control on the front of the TDR. This control is set so that the detected pulse is made the same height on the CRT screen as the transmitted pulse. The dB value is then read off the dial and noted (see Figure 3.1). Using the network flowchart, add up all the virtual dB losses up to the point of the detected pulse. Subtract this dB value from the noted dial reading. The resultant figure should be greater than or equal to 18 dB. Any value less than this is considered a network fault and should be corrected. (Less is towards 0 dB.) Table 3.1 is a summary of transmission component losses.

Table 3-1. Summary of Transmission Losses

Component	Path	Loss
Tap	Trunk Path	1.0 dB
	Trunk to Drop	10 or 12 dB*
Splitter	Each Path	3.0 dB
1/2 in. C.A.T.V. @ 1.544 MHz		.8 dB/1000'
RG-11/U @ 1.544 MHz		2.0 dB/1000'
RG-6/U @ 1.544 MHz		7.0 dB/1000'

***depending on the tap used (Extronics or Modicon)**

The accuracy of these measurements degrade after a 7000 foot distance and will not give useful return loss figures. The cable should be tested in portions.

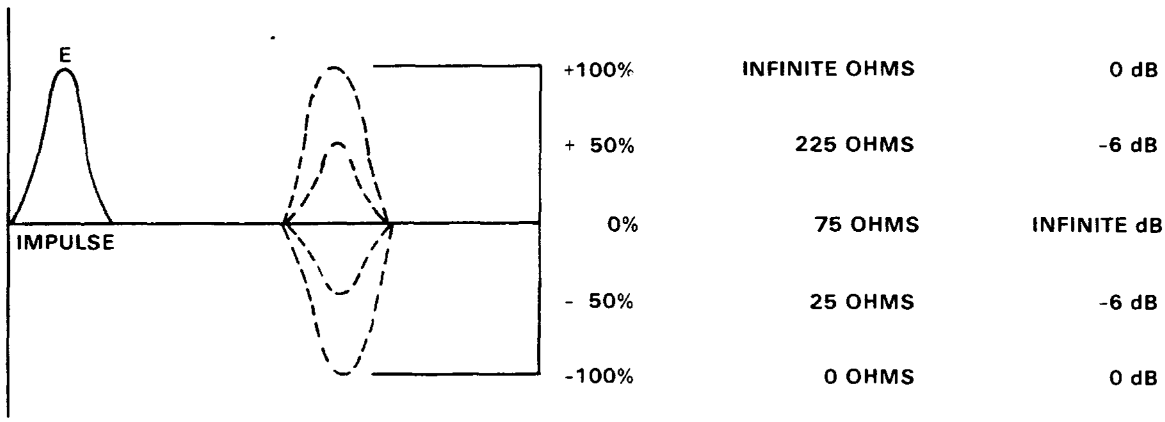

Figure 3-1. Sample Impedance Mismatches

NOTE

Configurations where several taps are close to each other on the main trunk (less than 200' between adjacent taps) will give a misleading reading on the T.D.R. The indicated return loss will be the sum of the return losses from each of the taps. This can be avoided by removing taps that are close together and replacing them with barrel connectors during this test. Refer to Figure 3.2.

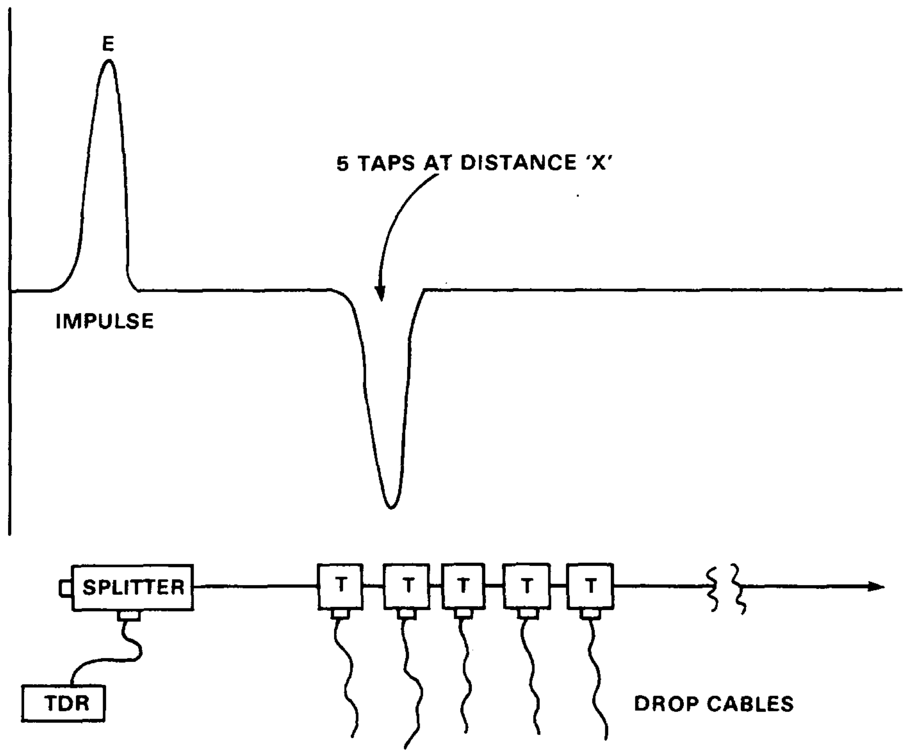

Figure 3-2. T.D.R. Reading for System with Closely Spaced Taps

Before connecting R.I.O. devices, a network profile should be recorded via the T.D.R. printer and should be kept.

This enables future comparisons to be made if the network integrity is suspect due to possible damage.

It should be noted that long cable runs produce a standing wave on the TDR waveform (see Figure 3.3). When this occurs, the actual waveform baseline should be used for return loss measurements.

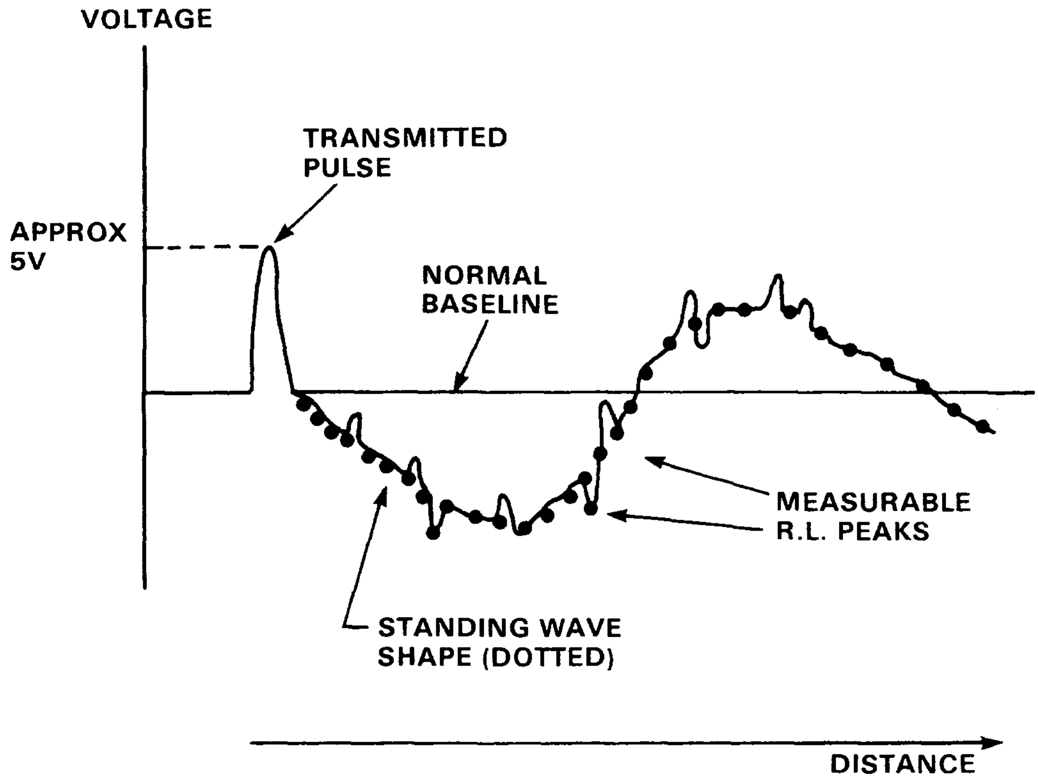

Figure 3-3. T.D.R. Reading for Long Cable Run

3.3.3 Transmission Loss Measurements

These checks are to ensure that the actual cabling and in-line insertion losses are in agreement with calculated losses and are less than the maximum allowable insertion loss (35 dB). For users with a model LMT/LMR 1544, follow Procedure A. Users with an oscilliscope should use Procedure B.

Procedure A

1. Properly terminate all drops except the J200 drop. (NOTE: If terminated with R.I.O. power supplies, these must all be powered down.)

2. Connect main trunk coax (J200 end) to transmitter (LMT-1544). Turn unit on, and adjust according to data sheet (see Appendix C).

3. Connect LMR-1544 to each location and verify that actual loss is not greater than calculated loss. LMR-1544 Data Sheet is given in Appendix D. The LMR-1544 is 75 ohm terminated.

Procedure B

1. Properly terminate all drops either with units or 75 ohm impedences.

2. Connect frequency generator at the point where J200 will be installed.

3. Terminate the frequency generator output with 75 ohms, and adjust to 3.0 pp @ 1.544 MHz.

4. Remove 75 ohm terminator, and connect frequency generator to main cable.

5. Measure the voltage across the termination of each drop. Use the measurement and the formula below to calculate the loss for each drop. (The result should be a negative number.)

$$\text{dB loss} = 20 \log \frac{V\ in}{V\ out}$$

where = V in = frequency generator voltage (from step 3)

V out = drop voltage (from step 5)

3.3.4 Ground Loops

General

Refer to Figure 3.4 to test for this condition by placing an ohm meter between the J200 chassis and the separated F connector coax cable shield.

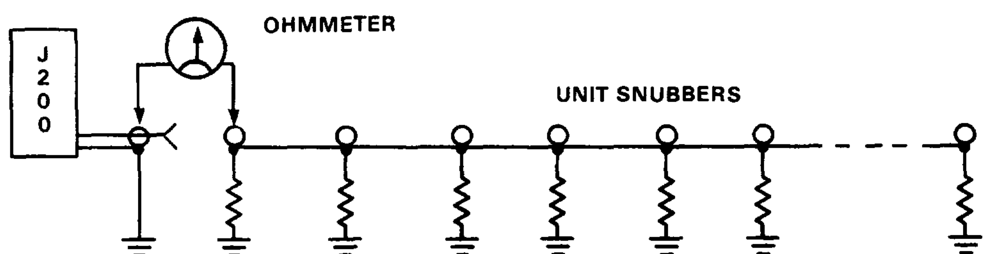

Figure 3-4. Placement of Ohm Meter for Ground Loop Test

NOTE

Signal ground and chassis ground are tied together at the J200 unit, and are separated by a snubber resistor at the P451 (100k ohm) and/or P453 (470k ohm) end.

If the resistance measured using the above method is close to the calculated value no ground loop exists. If the measured resistance is a very low value (1k ohm or less), the system should be checked for a coax braid short due to worn outer insulation, or a faulty snubber circuit in the P451 or P453 units.

- Resistance Calculation

1. If only P453 units are placed on the system, use the following equation.

$$*A = \frac{\text{P453 Snubber Value (470k ohm)}}{\text{\# of P453 units on the system}}$$

*where A is the calculated resistance

2. If only P451 units are placed on the system, use the following equation.

$$*B = \frac{\text{P451 Snubber Value (100k ohm)}}{\text{\# of P451 units on the system}}$$

*where B is the calculated resistance

3. If a mixture of P453 and P451 units are place on the system, use the following equation.

$$*C = \frac{A \times B}{A + B}$$

*where C is the calculated resistance

- System example for resistance calculation.

Refer to Figure 3.5.

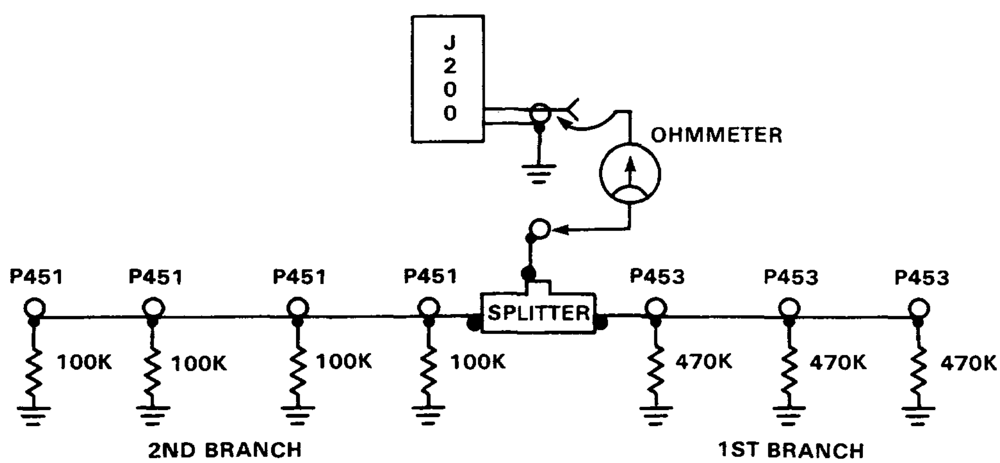

Figure 3-5. Placement of Ohm Meter for Resistance Measurement

NOTES

1. For the previous example (which incorporates a splitter), each branch should be calculated and checked separately.

2. Where a single cable run is used (which incorporates taps and not a splitter), the calculation and check should be done on the entire run.

Step 1 First branch calculation and check. (Disconnect second branch completely.)

$$A = \frac{470}{2} \times 10^3 = 235k \text{ ohm}$$

$$B = \frac{10^5}{2} = 50k \text{ ohm}$$

$$\text{TOTAL } C = \frac{(235 \times 50)}{(235 + 50)} \text{ k ohm}$$

Therefore, C = <u>41.2k ohm</u>

Now use the ohm meter to measure the actual value. This should be approximately (within $\pm$ 15%) 41k ohms.

Step 2 Second branch calculation and check.

Reconnect second branch and disconnect first branch of the system.

$$B = \frac{10^5}{4} = 25k \text{ ohm}$$

Therefore, total calculated resistance in this case is 25k ohm.

Now use the ohm meter to measure the actual value. This should be approximately (within $\pm$ 15%) 25k ohms.

If, in either of the two steps above, a very low resistance value is detected (less than or equal to 1k ohm), perform the following steps.

Step 1 Leave the ohm meter connected to the faulty branch.

Step 2 Systematically remove each supply from that branch and check the ohm meter until a substantial jump in resistance occurs. This indicates the last supply's snubber circuit is faulty. Check the value you are measuring now with a recalculation.

Step 3 If all the supplies have been removed and the ground loop still exists, the fault lies in the coaxial cabling. Sections can be isolated and checked by disconnecting them at various taps.