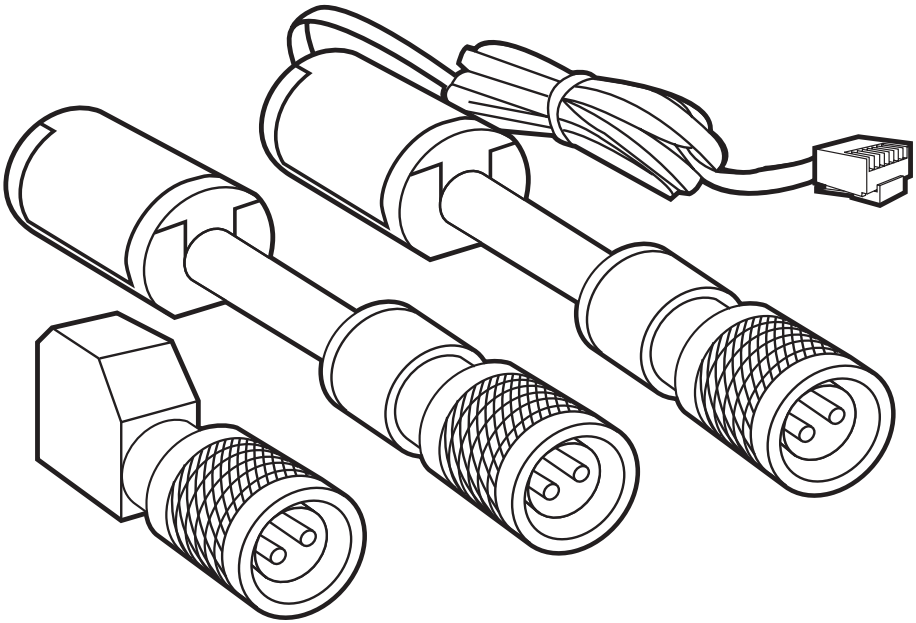
BLACK BOX®
NETWORK SERVICES

MARCH 1996
IC008, IC029A
IC036, IC064
IC064E, IC065
IC065E, IC066A
IC067A, IC068A

Twinaxial↔Twisted Pair/RJ-11 Balun
Twinaxial↔RJ-11 Balun w/Cable
Twinax Balun II
Twinaxial↔Twisted Pair/RJ-45 Balun
Mini Twinaxial↔Twisted Pair Balun



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FEDERAL COMMUNICATIONS COMMISSION
AND
INDUSTRY CANADA
RADIO FREQUENCY INTERFERENCE STATEMENTS

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

IC064E and IC065E are CE approved.

NORMAS OFICIALES MEXICANAS (NOM)
ELECTRICAL SAFETY STATEMENT

INSTRUCCIONES DE SEGURIDAD

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.

2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.

3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.

4. Todas las instrucciones de operación y uso deben ser seguidas.

5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..

6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.

7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.

8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.

9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato eléctrico sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.

10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.

11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.

13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.

14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.

15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.

16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.

17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.

18. Servicio por personal calificado deberá ser provisto cuando:

    A: El cable de poder o el contacto ha sido dañado; u

    B: Objectos han caído o líquido ha sido derramado dentro del aparato; o

    C: El aparato ha sido expuesto a la lluvia; o

    D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o

    E: El aparato ha sido tirado o su cubierta ha sido dañada.

TRADEMARKS

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Table of Contents

1. Specifications 8

2. Introduction 10

3. Installation, Operation, and Troubleshooting 12

3.1 Balun Installation 12
3.2 Cabling 14
3.3 Common Cable Problems 15
3.4 Troubleshooting 19

1. Specifications

System Requirements — All terminals and printers supported by Systems 34/36/38 and AS/400®

Connectors —

IC008:	(1) male twinax, (2) screw terminals, (1) female RJ-11
IC029A:	(1) male twinax, (1) male RJ-11 at the end of a 15-foot cable
IC036:	(1) male twinax, (2) screw terminals, (1) female RJ-11
IC064:	(1) male twinax; (1) female RJ-45
IC064E:	(1) male twinax; (1) female RJ-45 (shielded)
IC065:	(1) male twinax; (1) female RJ-45
IC065E:	(1) male twinax; (1) female RJ-45 (shielded)
IC066A:	(1) male twinax; (1) female RJ-11
IC067A:	(1) male twinax; (1) female RJ-45
IC068A:	(1) male twinax; (1) female RJ-45

Pin Configuration —

IC008:	Ring: Pin 3; Tip: Pin 4
IC029A:	Ring: Pin 3; Tip: Pin 4
IC036:	Ring: Pin 5; Tip: Pin 2
IC064:	Active Pins: 1 and 2
IC065:	Active Pins: 4 and 5
IC066A:	Ring: Pin 3; Tip: Pin 4
IC067A:	Active Pins: 4 and 5
IC068A:	Active Pins: 1 and 2

Data Format — Transparent to the user (Twinax)

Size —

IC008:	5"L x 1" Diameter (12.7 x 2.5 cm)
IC029A:	5"L x 1" Diameter (12.7 x 2.5 cm), includes a 15-ft. (4.6-m) RJ-11 cable
IC036:	5"L x 1" Diameter (12.7 x 2.5 cm)
IC064:	5"L x 1" Diameter (12.7 x 2.5 cm)
IC065:	5"L x 1" Diameter (12.7 x 2.5 cm)
IC066A:	1"H x 2.35"W x 0.625"D (2.5 x 6 x 1.6 cm)
IC067A:	1"H x 2.35"W x 0.625"D (2.5 x 6 x 1.6 cm)
IC068A:	1"H x 2.35"W x 0.625"D (2.5 x 6 x 1.6 cm)

Maximum Distance — The following charts are based on an IBM® System 36 and a passive star panel. The distances are not relevant to AS/400 environments. Use an active star panel with AS/400.

Table 1. Unshielded Twinax Balun Distances

Number of Terminals	Distance: Feet (Meters)	
	22 AWG	24 AWG
1	3500 (1067)	3000 (914)
2	3000 (914)	2700 (823)
3	2600 (792)	2300 (701)
4	2300 (701)	2000 (610)
5	1800 (549)	1500 (457)
6	1500 (457)	1200 (366)
7	1000 (305)	700 (213)

Table 2. Shielded Twinax Balun Distances

Number of Terminals	Distance: Feet (Meters)	
	22 AWG	24 AWG
1	3800 (1158)	3500 (1067)
2	3000 (914)	2700 (823)
3	2600 (792)	2300 (701)
4	2300 (701)	2000 (610)
5	1800 (549)	1500 (457)
6	1500 (457)	1200 (366)
7	1000 (305)	700 (213)

Speed — 1 Mbps

Power — None required

Temperature — Operating: 32 to 104° F (0 to 40° C)
Storage: -4 to 185° F (-20 to 85° C)

Humidity — Up to 95% non-condensing

2. Introduction

A variety of baluns are available to accommodate different twinax environments. All of the models allow you to use inexpensive twisted-pair cable instead of twinaxial cable.

When you use twinax cable, the last device on the line must be terminated (switch set to position 1). All other devices on the line must be unterminated (switch set to position 2).

When using twisted-pair cable and a star panel (whether active or passive), each device must be terminated because each is, in effect, the last device on its line. There is no cable through.

Although the distance between devices on the line is up to you, the total length of twisted pair must not exceed the maximum distance shown in Table 1 or 2 on page 9. This maximum distance varies depending on the number of terminals and the type of wire used. For models with unshielded RJ-11 or RJ-45 connectors (IC008, IC029A, IC036, IC064, IC065, IC066A, IC067A, and IC068A), the cable must be unshielded, low-capacitance twisted pair. For models with shielded RJ-45 connectors—IC064E and IC065E—the cable can be either shielded or unshielded twisted pair. See **Section 3.2** for a full description and recommendations for your cabling.

If you need to run your cable beyond the recommended distance specified in Tables 1 and 2, you might be able to use a repeater to reach the desired destination. For example, if you have 7 terminals and need to run your cable 3000 ft. (914 m), you might be able to do it with a repeater. This will depend on where your repeater is located. Call for technical support if you need further assistance.

Figure 1 shows an installation using the Twinaxial↔Twisted Pair Balun (IC008) and twisted-pair cable. With the IC008, you can use the screw terminal or the RJ-11 connector at either end.

The RJ-11 connection uses the naming convention of “tip” and “ring.” These are terms that have been passed down from the old telephone system. An operator would plug in a patch between two ports. The end of the plug (the “tip”) was the live connection. The black band around the plug for grounding was the “ring” line. “Tip” and “ring” have since become associated with a dial connection.

Since RJ-45 connectors do not use a dial connection, there are no references to tip and ring when these connectors are used.

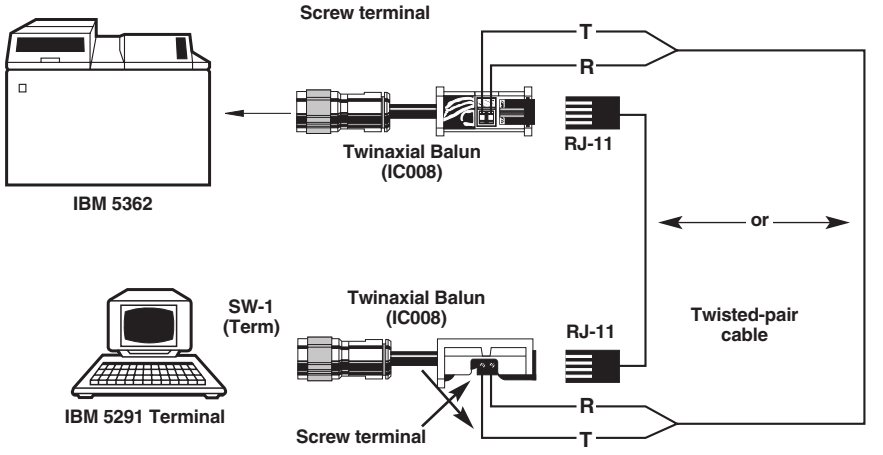

Figure 1. Typical installation for the Twinaxial↔Twisted Pair Balun (Single Port Configuration). A twisted-pair cable can use the screw terminal or the RJ-11 connector at either end.

3. Installation, Operation, and Troubleshooting

3.1 Balun Installation

To install the balun, follow these steps:

1. Identify the pin configuration (see **Figures 3** and **4**).

2. Connect one end to the IBM® controller's twinaxial port.

3, Connect the other end of the balun to the twisted-pair cable with with an RJ-11 connector, RJ-45 connector, or screw terminal (depending on which Balun you have purchased).

NOTE

If you are using a screw terminal, strip 0.250" (0.635 cm) of insulation from the end of the twisted pair, connect the wires to the terminal block, and tighten the locking screws.

4. If your balun has an RJ-11 connector—model IC008, IC029A, IC036, IC066A, IC067A, or IC068A—make sure that the Tip (T) and Ring (R) on one side is connected to the corresponding Tip (T) and Ring (R) on the other side. For example, for a balun designated as R3T4, the "RING" is pin 3 and and the "TIP" is pin 4.

NOTE

The baluns are polarity-sensitive.

5. At the other end of the communications link, connect the second balun to the device's twinaxial port and to the twisted-pair cable. The cable must be wired straight-through.

Baluns are often used with repeaters in larger network installations. By using repeaters such as the Multiple Twinax Repeater III (IC060A, IC069AE, IC061A, IC061AE-R2, IC062A, IC062AE, IC063A, or IC063AE-R2), you can use the less expensive and more convenient twisted-pair cable. Figure 2 shows a typical network configuration. With baluns and a repeater, one twinax port is used to support seven devices (which is the maximum number of devices that can run from one twinax port).

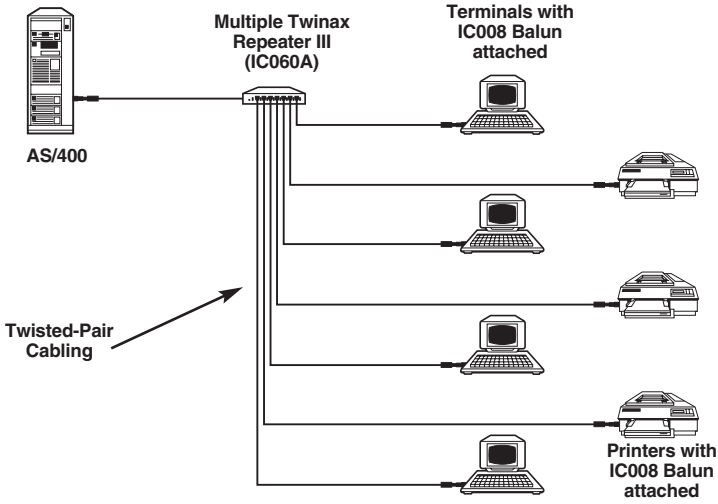

Figure 2. Up to seven devices can be connected to the twinax port of the host computer. By using baluns and a repeater, you can use existing twisted-pair cabling to reach your terminals or printers.

3.2 Cabling

Unshielded vs. Shielded Twisted-Pair Cable

We recommend that you use unshielded cable to wire a building for data transmission unless your local codes require shielded cable and connectors. For optimal results, we recommend that you use EYN712A or its equivalent. The cable should be 24 AWG (or lower) solid copper twisted-pair unshielded cable that meets the following specifications:

Nominal Impedance:
100 ohms at 1 MHz

Maximum Capacitance:
20 pF/foot

Maximum Attenuation:
6.6 db/1000 ft. at 1 MHz

If you are using unshielded cable that does not have the electrical characteristics specified above, the distances listed in Table 1 may be lower.

Shielded cable is not recommended because it usually has high nominal impedance. This may create an impedance mismatch on the line.

When using a shielded cable, you must ground the shield from one end of the connection to the other. If this is not done, the shield will act as an antenna and pick up electromagnetic or radio-frequency interference.

Unless you are using low-capacitance shielded wiring, your cable will have a much greater capacitance than 20 pF/foot, resulting in greater signal attenuation and shorter distance capability. Maximum attainable distance for shielded cable is typically a third of its rated distance.

Solid Copper vs. Stranded Wires

We suggest that you use solid copper over stranded wire, because stranded wire has a capacitance higher than 20 pF/foot. The capacitance of stranded wire is, however, lower than that of shielded cable. The use of stranded cable is acceptable, but it will not be as efficient as solid copper wire for achieving maximum distances.

Flat RJ-11 Cable

Using flat satin cable (telephone extension cords) is recommended only for patching purposes. When you use flat cable, the maximum length between the controller and any terminal should not exceed 15 feet (4 m). If possible, try to use twisted-pair wiring instead of flat cable. Flat cable is not considered to be a reliable transmission medium.

IBM Type 1 and 2 Cable

With these baluns, you cannot convert twinax cables to IBM Type 1 and 2 cable.

Using Riser Cables

When using riser cables containing more than 25 pairs, we recommend that you arrange these in binder groups. Each group should have a maximum of 25 pairs. This will minimize crosstalk between the different pairs.

Do not split pairs when making connections. A pair is two wires that share the same colors. For example, White base and Blue band wire forms a pair with Blue base and White band wire.

Cable Length Evaluation

For every connection a cable passes through, there is often a slight loss of signal strength. Such connections include 66 blocks and wall panels. Each connection subtracts approximately 10 ft. (3 m) from the maximum attainable distance.

Use the following equation to estimate the effective length of a twisted-pair run:

C = A + (B * 10 feet)

Where:

A = Physical length of cable in feet
B = Number of connections in the cable loop
C = Effective cable length for the system in feet

For example, if you wish to run 30 feet (9 m) of cable (A) and have 7 connections in the cable loop, the effective length for the system would be 100 feet (30.5 m).

C = 30 + (7 * 10 feet)

3.3 Common Cable Problems

This section outlines the common errors associated with wiring cable:

- incorrect pinouts
- reverse signal polarity
- loss of continuity
- interface problems

Modular Jack Pin-out

Figure 4 illustrates modular jack pin-out conventions for RJ-11. The standard is Pin 3 for Ring and Pin 4 for Tip. This is a straight-pinned cable.

Telephone wiring systems usually take Pins 3 and 4 for voice and data transmission. Some wiring systems, like ROLM, use Pins 3 and 4 for voice and Pins 2 and 5 for data so as to prevent a user from accidentally plugging a data terminal into a voice line and damaging the equipment. Some IBM equipment, such as the 5299 modular panel, also requires pins 2 and 5 to be active.

It is important to verify that the pin configuration of the baluns corresponds to the pin configuration used in the building's wiring scheme.

Figure 4 illustrates modular jack pin-out conventions for RJ-45. It also is a straight-pinned cable.

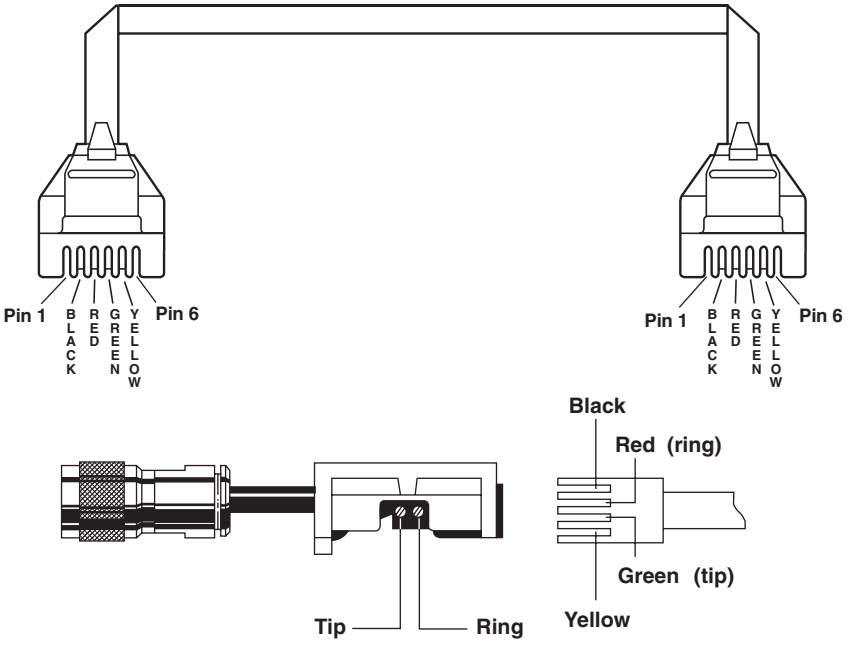

Figure 3. Modular jack pin-out conventions for RJ-11.

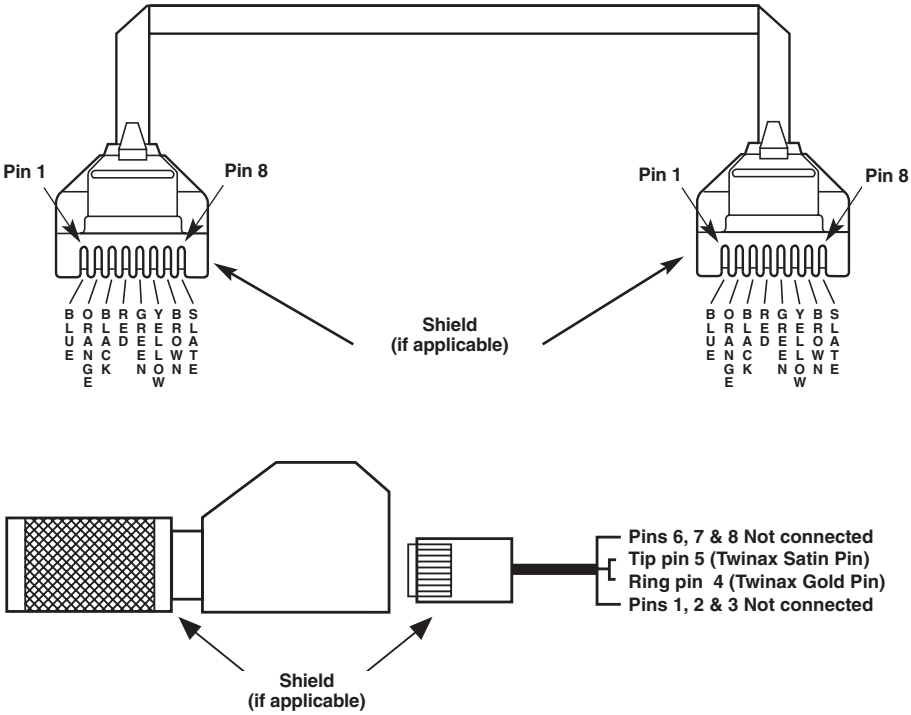

Figure 4. Modular jack pin-out conventions for RJ-45.

Polarity Problems

Baluns are polarity-sensitive. Cables must be wired straight-through, as in Figure 3 (Tip to Tip and Ring to Ring) and Figure 4. Data will not be transmitted if there are crossovers on the cable. If your terminal will not work, and distance is within specified limits, try reversing Tip and Ring at one of the baluns.

DC Loop Resistance Test

One way to verify the continuity of your link is to perform a DC Loop Resistance Test. This will tell you if you have exceeded the total distance for your cable or if your link is bad (short circuits, open circuits, loose connections, or badly crimped connectors, etc.). Figure 5 shows how to perform the DC Loop Resistance Test with the help of a multimeter set at the Ohm position.

Make sure that the two wires at the opposite end of the the multimeter are shorted together. Table 3 illustrates the different resistance values for various cable types and distances.

NOTE: Baluns do not maintain DC continuity. If an ohmmeter is used, the balun will appear to be shorted from Tip and Ring. The twinax pins will also appear to be shorted. This is normal.

Table 3. Typical Cable DC Resistances

Cable Size	DC Resistance per 1000 feet	DC Loop Resistance (Ohms)				
		600'	1200'	2400'	3000'	3500'
22 AWG	16.0 Ohms	19	38	77	96	112
24 AWG	26.0 Ohms	31	62	125	156	182

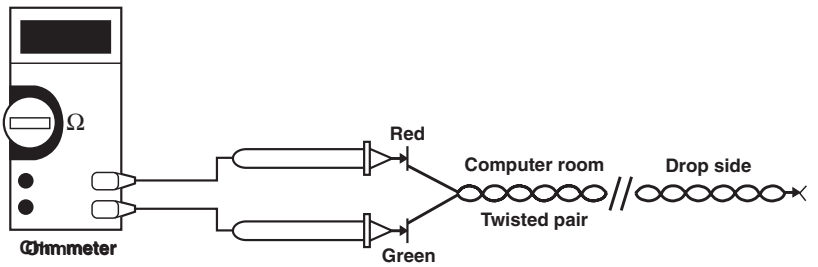

Figure 5. DC Loop Resistance Test.

Interference Problems

When installing cable, try to avoid all sources of electromagnetic interference such as fluorescent lighting, high-power lines, electric motors, and power transformers. Data wiring should be at least:

- 5" (12.7 cm) from power lines of 2 KVA or less;
- 12" (30.5 cm) from fluorescent lighting and power lines between 2 and 5 KVA;
- 36" (91.5 cm) from power lines greater than 5 KVA;
- 40" (101.6 cm) from transformers and motors.

3.4 Troubleshooting

Before hooking up the System 3X or AS/400® with baluns, we suggest that you conduct a few tests directly at the controller site. This will ensure that the 3X or AS/400 system will function as it should.

If a terminal is not working:

1. Is the 3X controller port in operation?

2. Is the terminal in question connected to the right port?

3. Has the cable distance been exceeded? If so, then a booster may be needed on the line to increase distance.

4. Is signal polarity observed?

5. Is there a signal at the terminal side? If you are using an oscilloscope, there should be at least 500 mVp-p measured at the terminal.

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