OCTOBER 1998

AC810A-R3	**AC811C**
AC810AE-R3	**AC812A-R2**
AC810C	**AC812AE-R2**
AC810C-E	**AC813A**
AC811A-R3	**AC814A-R2**
AC811AE-R3	**AC814AE-R2**
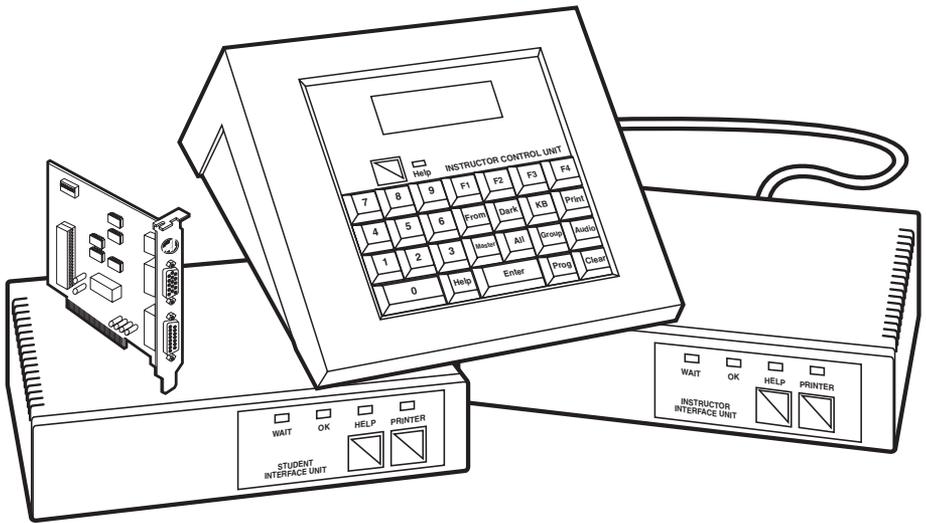
◆**BLACK BOX**®
NETWORK SERVICES

ClassWork Plus

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 la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

(CE)

The CE symbol on your equipment indicates that it complies with the Electromagnetic Compatibility (EMC) directive and the Low Voltage Directive (LVD) of the Union European (EU).

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

AT®, PS/2®, and XGA® are registered trademarks of IBM Corporation.

Pentium® is a registered trademark of Intel Corporation.

Windows® is a registered trademark of Microsoft Corporation.

Contents

1. Specifications

General

Video Bandwidth—350 MHz

Keyboard Emulation—PC or PS/2 type

Mouse Emulation—RS-232 or PS/2 type

Stations Supported—Up to 63 students

Instructor Unit:

Leads Supported—VGA, SVGA, XGA (DB15HD), 5-pin keyboard,
6-pin mini DIN (PS/2 style) keyboard, serial mouse (DB9), 6-pin mini
DIN (PS/2 style) mouse, RS-232 comm port

Connectors—Control Unit: 5-pin DIN female;
Interface Unit—Instructor: 9 VAC power jack, stereo jack for comm
port, DB9 female for keyboard adapter, DB9 male for mouse adapter,
(2) DB25 female for system cables, (1) DB15HD male VGA screen in,
(1) DB15HD female VGA screen out, 5-pin DIN female for control-
panel connection

Operating System—For Communications Software: DOS Version 3.3 and
above; Windows Version 3.1 and above

Size—Instructor Control Unit: 3.6"H x 8.6"W x 9"D (9.1 x 21.8 x 22.9 cm)
Instructor Interface Unit: 2"H x 8.9"W x 6.5"D (5.1 x 22.6 x 16.5 cm)

Instructor Unit Card (AC810C, AC810C-E):

Connectors—(1) 8-pin Mini DIN female, (1) DB15 HD female, (1) DB15 female

Power—AC810C: 120 VAC; AC810C-E: 240 VAC

Size—¼ card

Student Unit:

Leads Supported—VGA, SVGA, XGA (DB15HD), 5-pin keyboard,
6 pin mini DIN (PS/2 style) keyboard, serial mouse (DB9), 6-pin mini
DIN (PS/2 style) mouse, RS-232 comm port

Connectors—Student Interface Unit: 9-VAC power jack, stereo jack for comm port, DB9 female for keyboard adapter, DB9 male for mouse adapter, (2) DB25 female for system cables, (1) DB15HD male VGA screen in, (1) DB15HD female VGA screen out

Operating System—For Communication Software: DOS Version 3.3 and above; Windows Version 3.1 and above

Size—Student Interface Unit: 2"H x 6.7"W x 6.5"D (5.1 x 19.6 x 16.5 cm)

Student Unit Card (AC811C):

Connectors—(1) 8-pin Mini DIN female, (1) DB15 HD female, (1) DB15 female

Power—From ISA slot interface

Size—¼ card

2. Introduction

Using ClassWork Plus increases the efficiency of the lesson in the computerized classroom, and gives the instructor better control over class resources. It connects the instructor's computer to up to 63 student computers, providing the instructor with as much (or as little) control as deemed appropriate.

ClassWork Plus is very easy to install and use. This manual provides system installation and operation instructions.
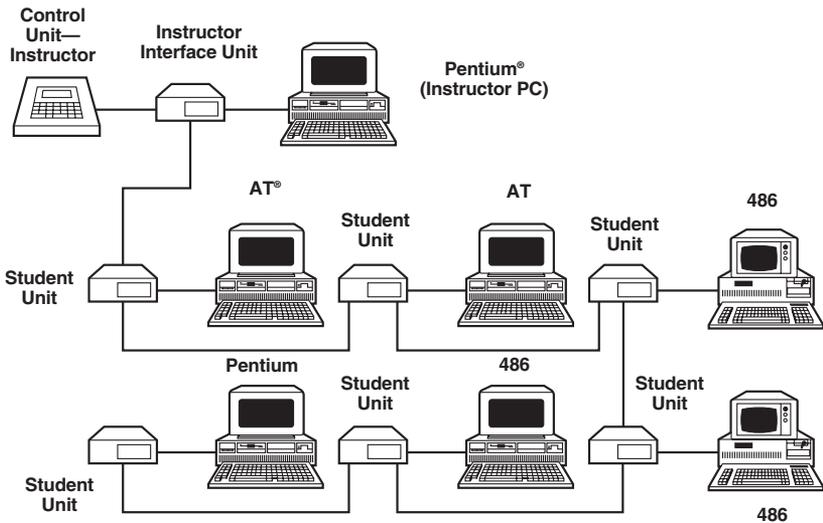
Fig. 2-1. Typical Configuration Using Standalone Units.
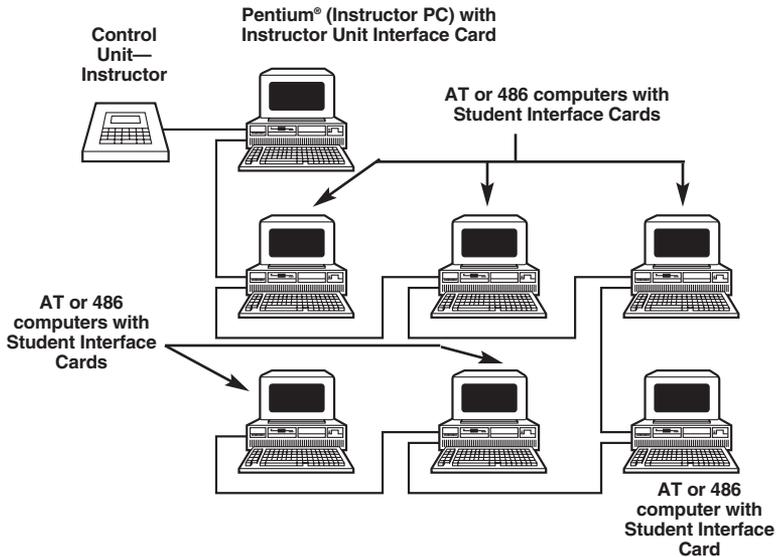
Figure 2-2. Typical Configuration Using Card Versions.

2.1 Configuration

ClassWork Plus is compatible with all PC and PS/2 computers and compatibles with VGA, SVGA, or XGA® screens. Keyboard and mouse cables are ordered separately.

ClassWork Plus is a modular system, providing basic functions. Communication software, printer spooler, multimedia support, and classroom intercom may be added to the system according to user requirements. Up to 63 students may be connected to the system.

The basic functions of the system are hardware-based, independent of the operating system or network used.

2.2 Components

These are the components that make up the system:

- ClassWork Plus—Instructor Unit Kit (AC810A-R3 or AC810AE-R3) consists of:

- Instructor Control Unit (AC813A), consisting of function display and ergonomic click keypad. The instructor activates all functions via this unit.

- Instructor Interface Unit (AC812A-R2, AC812AE-R2), located near the instructor's position, connecting the instructor's computer to the ClassWork Plus system.

- (1) 6-ft. (1.8-m) 5-pin DIN cable M/M to connect the Instructor Control Unit to the instructor interface unit

- Power supply, external 115 VAC or 230 VAC for Instructor Interface Unit

- (2) DB25 male terminators

- (1) 5-ft. (1.5-m) DB15HD M/F VGA screen cable

- (2) 3.5" diskettes (1 DOS, 1 Windows®) communications (file-transfer) software

- This user's manual

• ClassWork Plus—Student Interface Kit (AC811A-R3 and AC811AE-R3) includes the following:

- Student Interface Unit (AC814A-R2, AC814AE-R2)

- Power supply, external 115 VAC or 230 VAC, for Student Interface Unit

- (1) 6.6-ft. (2-m) DB25 M/M network cable

- (1) 5-ft. (1.5-m) DB15HD M/F VGA screen cable

   Also available are Instructor and Student Interface Cards, which you can use in place of the Interface Units:

• ClassWork Plus—Instructor PC Card (AC810C)

• ClassWork Plus—Student PC Card (AC811C)

Depending on what computers you use, you will need some or all of these cables:

• PS/2 Keyboard Cable, DB9 M "Y" cable to (2) 6-pin mini DIN

• PS/2 Mouse Cable, DB9F "Y" cable to (2) 6-pin mini DIN

• PC Keyboard Cable, DB9M "Y" cable to (2) 5-pin DIN M/F keyboard (FA211, FA212 6-pin adapters available)

• PC Mouse Cable, DB9F "Y" cable to (2) DB9 M/F serial

• Communication Cable, stereo plug to DB9F (connects to comm port; DB25 to DB9 adapters available)

2.3 Communication Software

Whether the Instructor wants to transfer one or many files to all the students, or just a small group, or to send a message to one student or to the entire class—the Communication Software makes this as easy as pressing a button.

   Without the Communication Software, these operations would have to be carried out either by transferring files physically from computer to computer using floppy disks, or by connecting all the computers together as a network. The Communication Software guides the instructor through the operation—with the Help option available every step of the way—so that what would normally be a lengthy and time-consuming process becomes simple and quick.

3. Installing ClassWork Plus— (AC810A-R3, AC811A-R3)

3.1 Before Starting

The system is connected as a daisychain topology. The instructor's position can be anywhere in the chain, either at the end or in the middle. **Figures 3-8** through **3-15**, at the end of this chapter, show all the cables that go with the system.

Place the Instructor Control Unit on the instructor's desk, near the instructor's computer.

Place the Instructor Interface Unit near the instructor's position, so that the instructor can easily access its connectors.

Put the instructor's set of cables near the Instructor Interface Unit.

Put every Student Unit and its set of cables near the appropriate student computer—Student Unit #1 near student #1, etc. You can connect the units in any order. The student's number appears on the back panel of the Student Unit.

Place the system cables between the stations so that there will be access to their connectors near each unit. Set one terminator at each end of the daisychain.

Turn OFF all computers.

Disconnect screen, keyboard, and mouse in all computers.

3.2 Setting Student Unit Number

The Student Unit number is set via a DIP switch, located at the bottom of the box. Use **Table 3-1** to set the number.

Table 3-1. DIP Switch Settings for Student Unit Number.

Address	Switch Setting					
	1	2	3	4	5	6
1	▲	▽	▽	▽	▽	▽
2	▽	▲	▽	▽	▽	▽
3	▲	▲	▽	▽	▽	▽
4	▽	▽	▲	▽	▽	▽
5	▲	▽	▲	▽	▽	▽
6	▽	▲	▲	▽	▽	▽
7	▲	▲	▲	▽	▽	▽
8	▽	▽	▽	▲	▽	▽
9	▲	▽	▽	▲	▽	▽
10	▽	▲	▽	▲	▽	▽
11	▲	▲	▽	▲	▽	▽
12	▽	▽	▲	▲	▽	▽
13	▲	▽	▲	▲	▽	▽
14	▽	▲	▲	▲	▽	▽
15	▲	▲	▲	▲	▽	▽
16	▽	▽	▽	▽	▲	▽
17	▲	▽	▽	▽	▲	▽
18	▽	▲	▽	▽	▲	▽
19	▲	▲	▽	▽	▲	▽
20	▽	▽	▲	▽	▲	▽
21	▲	▽	▲	▽	▲	▽
22	▽	▲	▲	▽	▲	▽
23	▲	▲	▲	▽	▲	▽

Table 3-1. DIP Switch Settings for Student Unit Number (continued).

Address	Switch Setting					
	1	2	3	4	5	6
24				●	●	
25	●			●	●	
26		●		●	●	
27	●	●		●	●	
28			●	●	●	
29	●		●	●	●	
30		●	●	●	●	
31	●	●	●	●	●	
32						●
33	●					●
34		●				●
35	●	●				●
36			●			●
37	●		●			●
38		●	●			●
39	●	●	●			●
40				●		●
41	●			●		●
42		●		●		●
43	●	●		●		●
44			●	●		●
45	●		●	●		●
46		●	●	●		●
47	●	●	●	●		●
48					●	●
49	●				●	●
50		●			●	●
51	●	●			●	●
52			●		●	●
53	●		●		●	●
54		●	●		●	●

Table 3-1. DIP Switch Settings for Student Unit Number (continued).

Address	Switch Setting					
	1	2	3	4	5	6
55						
56						
57						
58						
59						
60						
61						
62						
63						

You set the ID number on the Teacher and Student Interface Units using the DIP switches 1 to 6, as follows:
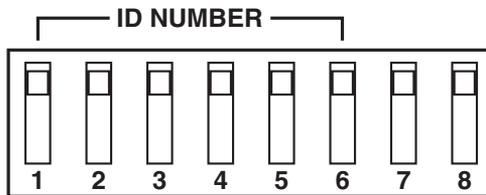
ID NUMBER

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Figure 3-2. Setting the ID Number.

3.3 Setting the DIP Switch for AT or PS/2

You use the ID Number DIP switch 7 and 8 and the PC/PS DIP switch to set the Instructor and Student Interface Units for AT (PC) or PS/2 (PS) as follows:

For PS/2 (PS), position DIP Switch 7 and 8 in the downward direction. See **Figure 3-1a** and set the PC/PS switch as shown in **Figure 3-1b**.
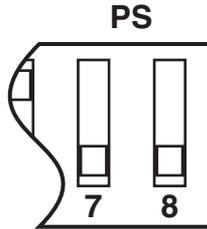
Figure 3-1a. ID Number DIP Switch

Figure 3-1b. PS DIP Switch ON.

For PC, position DIP Switch 7 and 8 in the upward direction. See **Figure 3-2a** and set the PC/PS switch as shown in **Figure 3-2b**.
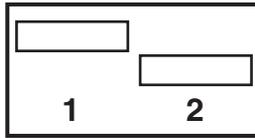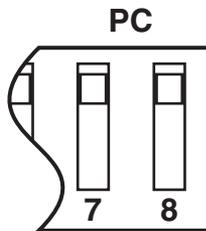

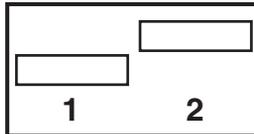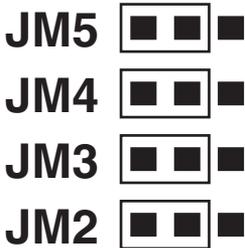**Figure 3-2a. ID Number DIP Switch.**

Figure 3-2b. PC DIP Switch ON.

3.4 Setting Mouse Mode

Each Instructor and Student Interface Unit comes preset to either serial-mouse or PS/2 mouse mode. To change this setting, open the unit and change the jumper position to the desired mode.
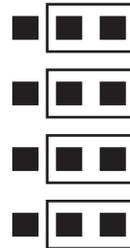
SERIAL MOUSE   PS/2 MOUSE

JM5 ■ ■ ■   ■ ■ ■

JM4 ■ ■ ■   ■ ■ ■

JM3 ■ ■ ■   ■ ■ ■

JM2 ■ ■ ■   ■ ■ ■

Fig. 3-3. Setting Mode Jumpers.

NOTE

Different mouse modes require different mouse cables. Verify that you have the correct cables.

3.5 Connecting ClassWork Plus

Instructor Unit (Standalone Unit):

1. Verify that the instructor's computer is turned OFF. The screen, keyboard, and mouse should be unplugged.

2. Connecting the screen:

A. Connect the monitor to the "screen out" socket of the Instructor Interface Unit.

B. Connect the screen cable between the VGA card of the instructor's computer and the "screen in" socket of the Instructor Interface Unit.

3. Connecting the keyboard:

A. Connect the common DB9 male connector of the keyboard in/out cable to the "KB" socket of the Instructor Interface Unit.

B. Connect the long portion of the keyboard in/out cable to the keyboard socket of the instructor's computer.

C. Connect the keyboard to the short portion of the keyboard in/out cable.

4. Connecting the mouse:

A. Connect the common DB9 female connector of the mouse in/out cable to the "mouse" socket of the Instructor's Interface Unit.

B. Connect the long portion of the mouse in/out cable to the mouse socket of the instructor's computer.

C. Connect the mouse to the short portion of the mouse in/out cable.

NOTE
DB9-to-DB25 adapters may be required.

5. Connect the 6-ft. 5-pin DIN Instructor's Control Unit cable between the control socket of the Instructor's Interface Unit and its socket at the Instructor's Control Unit.

6. Connect the Instructor's Interface Unit to the power system, via the power supply.

7. Connect both system cables to system sockets to create a daisychain. Then connect the system cable to the next station (if the Instructor's Unit is at the end of the line, insert a terminator instead of a system cable).

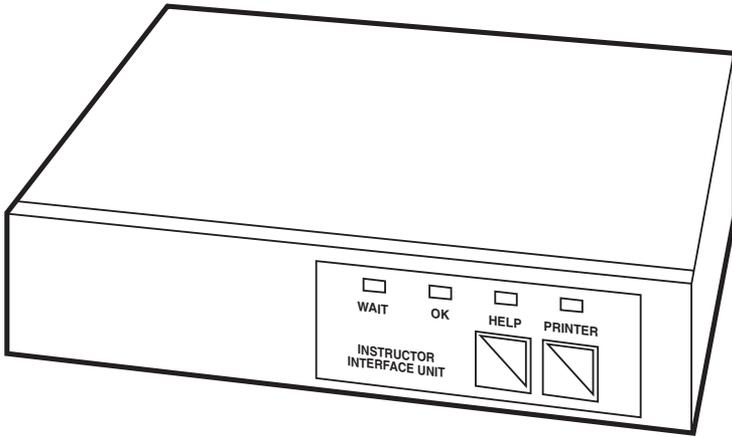The Instructor Unit is now ready for operation.

Fig. 3-4. Instructor Interface Unit.

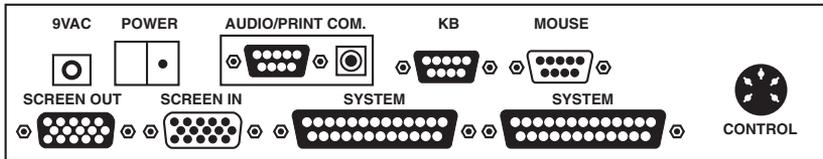

Fig. 3-5. Instructor Interface Unit, Rear View.

Student Units:

1. Verify that the student's computer is turned OFF. The screen, keyboard, and mouse should be unplugged.

2. Connecting the screen:

A. Connect the monitor to the screen out socket of the Student Unit.

B. Connect the screen cable between the VGA card of the student's computer and the screen in socket of the Student Unit.

3. Connecting the keyboard:

A. Connect the common DB9 male connector of the keyboard in/out cable to the "KB" socket of the Student Unit.

B. Connect the long portion of the keyboard in/out cable to the keyboard socket of the student's computer.

C. Connect the keyboard to the short portion of the keyboard in/out cable.

4. Connecting the mouse:

A. Connect the common DB9 female connector of the mouse in/out cable to the "mouse" socket of the Student Unit.

B. Connect the long portion of the mouse in/out cable to the mouse socket of the student's computer.

C. Connect the mouse to the short portion of the mouse in/out cable.

NOTE
DB9 to DB25 adapters may be required.

5. Connect the Student Unit to the power system, via the power supply.

6. Connect both system cables to the system sockets of the Student Unit to create a daisychain. (If the Student Unit is at the end of the line, insert a terminator instead of a system cable.)

The Student Unit is now ready for operation.

Fig. 3-6. Student Interface Unit.

9VAC   POWER   AUDIO/PRINT COM.   KB   MOUSE

SCREEN OUT   SCREEN IN   SYSTEM   SYSTEM
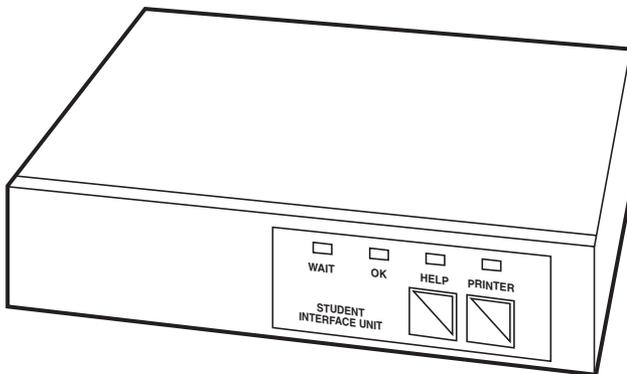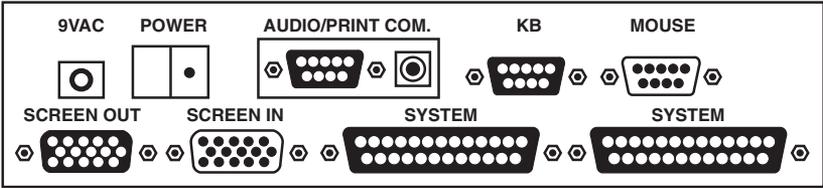
Fig. 3-7. Student Interface Unit, Rear View.
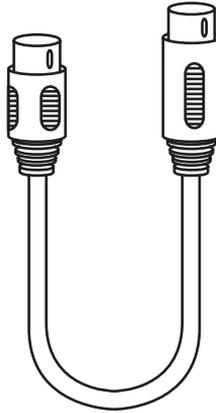
Cables
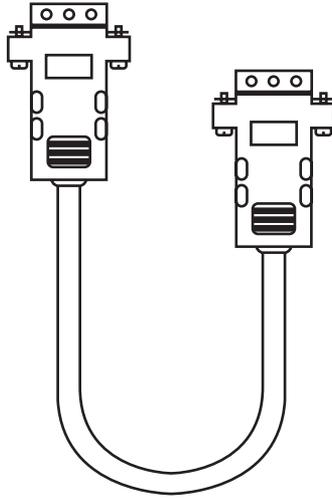
Fig. 3-8. Instructor Control Unit Cable (EVNBDC).

Fig. 3-9. Screen Cable (EVNPS05).
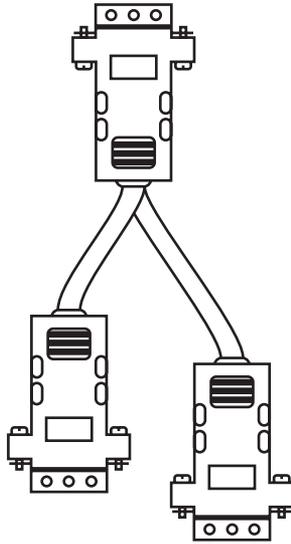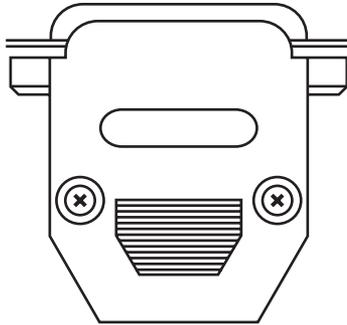
Fig. 3-10. Serial Mouse Cable.
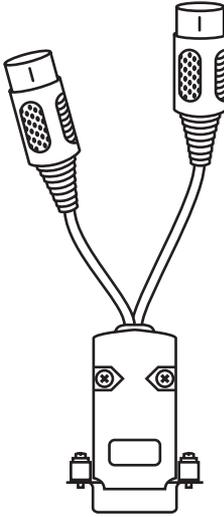

Fig. 3-11. Terminator.
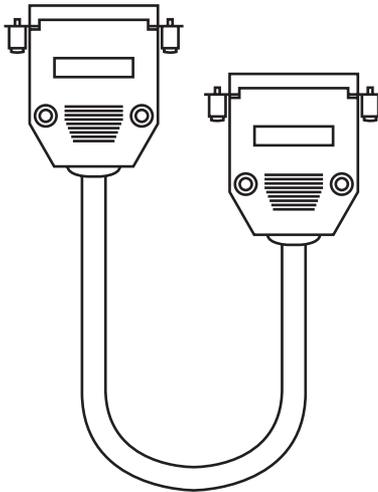
Fig. 3-12. PC Keyboard Cable.

Fig. 3-13. System Cable.
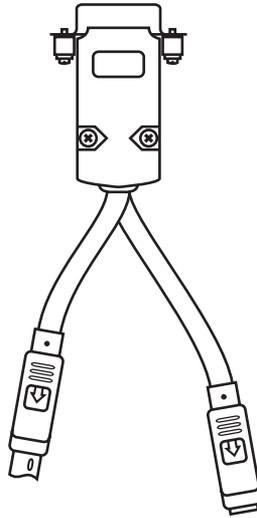
Fig. 3-14. Keyboard Cable for PS/2.
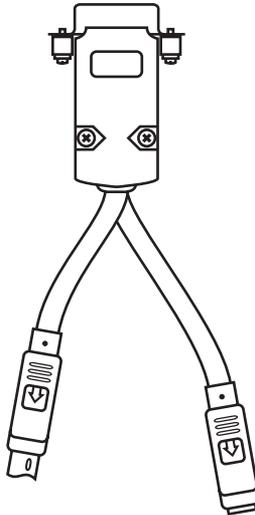
Fig. 3-15. Mouse Cable for PS/2.

4. Installing ClassWork Plus Board Version (Hardware Installation)

This chapter of the manual explains how to set up and install the hardware used in the ClassWork Plus Board Version system via the Instructor Control Unit.

4.1 Pre-Installation Requirements

Complete the checklist detailing ClassWork Plus's pre-installation Requirements before installing the ClassWork Plus Board Version system:

1. Check that all screens in the classroom are either VGA, SVGA, or XGA.

2. Check that the resolution display settings of all computers in the classroom are set to that of the lowest common denominator screen's capability in the classroom.

3. Check that all keyboards in the classroom are identical.

4. Check that all mice in the classroom are identical.

4.2 Planning Your Installation

Make the following pre-installation plans before you install the ClassWork Plus system for a smooth, trouble-free installation.

1. Make a drawing of your classroom indicating the location of each computer and the System Cables.

2. All computers need to be plugged into the same phase electrical outlet with a common ground. Check that all electrical outlets in the classroom have the same common ground.

3. Install additional Line Boosters for every 20 students, or for every 75 meters of System Cable. When using high-resolution monitors or when electrical conditions require there may be a need to add more Line Boosters to the system.

NOTE
The Instructor Interface unit may be located anywhere in the classroom.

4.3 Environmental Requirements

A number of environmental requirements need to be met before you install the ClassWork Plus system into the classroom. These environmental requirements are detailed in the **Appendix**.

4.4 Setting the ClassWork Plus Interface Board

You can install the ClassWork Plus Interface Board in a CPU that uses either a serial mouse and AT keyboard or a PS/2 mouse and keyboard.

Jumpers are used to select the operation modes for your Mouse. To set a jumper, a black cap containing metal contacts is clipped onto the jumper terminal pins, covering them. This action is known as *shorting* or *closing.* Jumper terminal pins left uncovered are referred to as *open.*

On the ClassWork Plus Interface Board where each jumper *shorts* two pins, *shorting* pin 2 and pin 3, for example, creates one setting, whereas *shorting* pin 1 and 2 would create another. You set the ClassWork Plus Interface Board to work in the AT Mouse format, by *shorting* Pin #2 and Pin #3, for JP4, JP3, JP2, and JP1, as shown in **Figure 4-1**. JP5 is *open.*
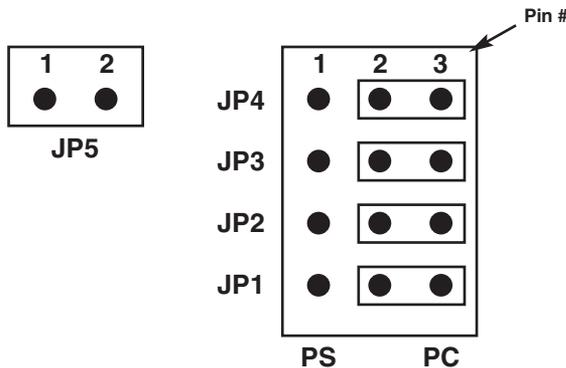
Figure 4-1. Jumper Settings for AT Mouse.

You set the ClassWork Plus Interface Board to work in the PS/2 format, by *shorting* Pin #1 and Pin #2, for JP4, JP3, JP2, and JP1, as shown in **Figure 4-2**. JP5 is *shorted*.
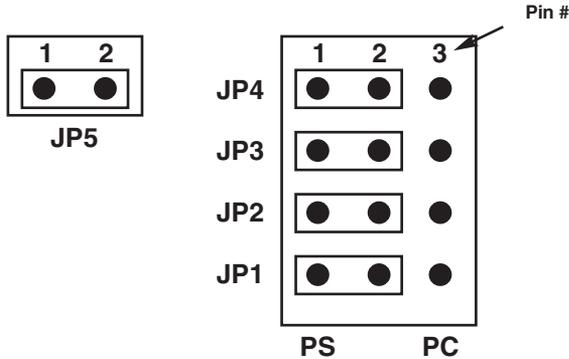
Figure 4-2. Jumper Settings for PS/2 Mouse.

4.5 Connecting the Student Position

This section of the chapter explains how to connect the hardware required to operate an individual student position. An individual student position consists of the student's computer plus the hardware required to hook it up.

4.5.1 STUDENT POSITION COMPONENTS

The student position consists of the following components:

- ClassWork Plus Interface Board

- I/O PC/AT or l/O PS/2 Adapter (DB15 male to (2) DB25 female)

- Video Control "Y" Cable ([1] DB15 HD male to [1] DB15 HD male and [1] DB15 HD female)

- System Cable Adapter

- System Cable (2.0 m) (DB25 male to DB25 male)

4.5.2 INSTALLING THE BOARD

1. Turn OFF and unplug the CPU.

2. Unplug the screen, keyboard, and mouse from the back of the CPU.

3. Open the cover of the CPU to expose the inside components.

4. In the back of the CPU, choose a free ISA slot in which to install the ClassWork Plus Interface Board.

5. Remove the bracket from the chosen slot. (Save the screw.)

6. Set the DIPswitch on the ClassWork Plus Interface Board (see below).

Setting the Student Number:

The Student Number is set by the DIP switch located in the lower right-hand corner of the ClassWork Plus Interface Board. **Table 4-1** shows how to set the Student Number.

Table 4-1. Setting the Student Number.

Student No.	Switch No.							
	1	2	3	4	5	6	7	8
0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	0	1	0	0	0	0	0	0
3	1	1	0	0	0	0	0	0
4	0	0	1	0	0	0	0	0
5	1	0	1	0	0	0	0	0
6	0	1	1	0	0	0	0	0
7	1	1	1	0	0	0	0	0
8	0	0	0	1	0	0	0	0
9	1	0	0	1	0	0	0	0
10	0	1	0	1	0	0	0	0
11	1	1	0	1	0	0	0	0
12	0	0	1	1	0	0	0	0
13	1	0	1	1	0	0	0	0
14	0	1	1	1	0	0	0	0
15	1	1	1	1	0	0	0	0
16	0	0	0	0	1	0	0	0
17	1	0	0	0	1	0	0	0
18	0	1	0	0	1	0	0	0
19	1	1	0	0	1	0	0	0
20	0	0	1	0	1	0	0	0
21	1	0	1	0	1	0	0	0
22	0	1	1	0	1	0	0	0
23	1	1	1	0	1	0	0	0
24	0	0	0	1	1	0	0	0
25	1	0	0	1	1	0	0	0
26	0	1	0	1	1	0	0	0
27	1	1	0	1	1	0	0	0
28	0	0	1	1	1	0	0	0
29	1	0	1	1	1	0	0	0
30	0	1	1	1	1	0	0	0
31	1	1	1	1	1	0	0	0
32	0	0	0	0	0	1	0	0
33	1	0	0	0	0	1	0	0
34	0	1	0	0	0	1	0	0
35	1	1	0	0	0	1	0	0
36	0	0	1	0	0	1	0	0

7. Set the jumpers on the ClassWork Plus Interface Board for either PS/2 or PC/AT (these procedures are explained in **Section 4.4**).

8. Insert the ClassWork Plus Interface Board into the chosen slot and screw it in.

9. Close the cover of the CPU.

4.5.3 CONNECTING THE CABLES

This section deals with the wiring of the different cables you will need to connect the student positions, and will detail the connection of each cable individually.

4.5.4 CONNECTING THE I/O ADAPTER

This section discusses connecting the student's screen, keyboard, and mouse to the student's position. The I/O Adapter is used to make the keyboard and mouse connections. The video cable is used to make the screen connections.

The ClassWork Plus Interface Board can be connected up with one of two I/O Adapters. The I/O Adapter used will depend on if the J student is using an AT keyboard and mouse, or a PS/2 keyboard and mouse.

If the student is using an AT keyboard and mouse do the following to connect the AT I/O Adapter (see **Figure 4-3**):

1. Connect the 8-pin mini-DIN male connector of the I/O Adapter to the 8-pin mini-DIN female port of the ClassWork Plus Interface Board.

2. Connect the D9 female mouse connector of the I/O Adapter to the D9 male mouse port of the CPU.

3. Connect the mouse to the DB9 male mouse connector of the I/O Adapter.

4. Connect the 5-pin DIN male keyboard connector of the I/O Adapter to the 5-pin DIN female keyboard port of the CPU.

5. Connect the keyboard to the 5-pin DIN female keyboard connector of the I/O Adapter.
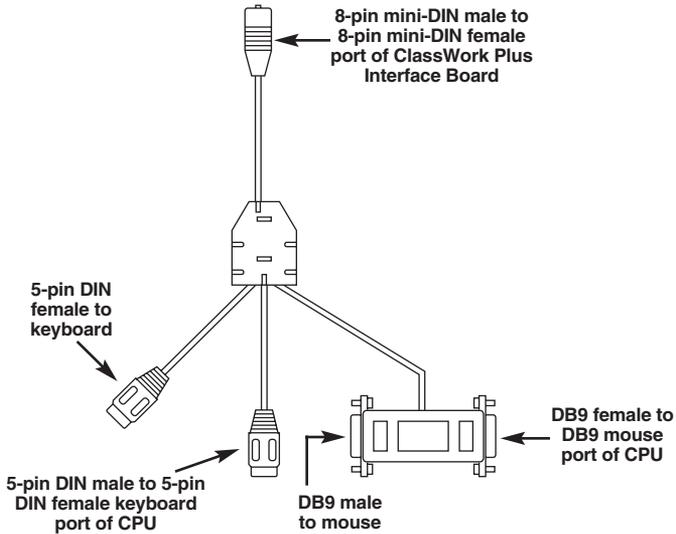
8-pin mini-DIN male to 8-pin mini-DIN female port of ClassWork Plus Interface Board

5-pin DIN female to keyboard

DB9 female to DB9 mouse port of CPU

5-pin DIN male to 5-pin DIN female keyboard port of CPU

DB9 male to mouse

Figure 4-3. I/O Adapter for AT Mouse.

If the student is using a PS/2 keyboard and mouse do the following to connect up the PS/2 I/O Adapter (see **Figure 4-4**):

1. Connect the 8-pin mini-DIN male connector of the I/O Adapter to the 8-pin mini-DIN female port of the ClassWork Plus Interface Board.

CAUTION

Do not confuse the 6-pin mini-DIN mouse connector with the Mini DIN 6 keyboard connector of the I/O Adapter. Each connector is specifically marked as to its purpose.

2. Connect the 6-pin mini-DIN male mouse connector of the I/O Adapter to the 6-pin mini-DIN female mouse port of the CPU.

3. Connect the mouse to the 6-pin mini-DIN female mouse connector of the I/O Adapter.

4. Connect the 6-pin mini-DIN male keyboard connector of the I/O Adapter to the 6-pin mini-DIN female keyboard port of the CPU.

5. Connect the keyboard to the 6-pin mini-DIN female keyboard connector of the l/O Adapter.
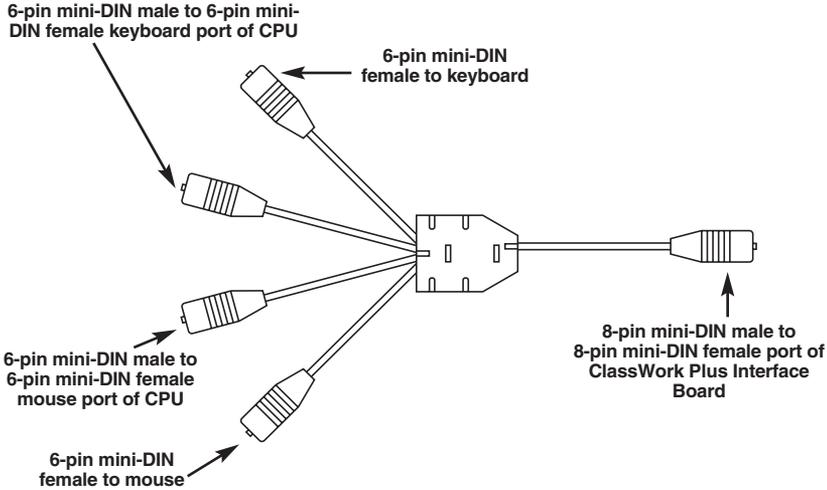
6-pin mini-DIN male to 6-pin mini-DIN female keyboard port of CPU

6-pin mini-DIN female to keyboard

6-pin mini-DIN male to 6-pin mini-DIN female mouse port of CPU

8-pin mini-DIN male to 8-pin mini-DIN female port of ClassWork Plus Interface Board

6-pin mini-DIN female to mouse

Figure 4-4. I/O Adapter for PS/2.

4.5.5 CONNECTING THE VIDEO CABLE

To connect the Video Monitor Cable, do the following:

1. Connect the HD15 male connector of the Video Monitor Cable to the HDI 5 female port of the ClassWork Plus Interface Board.

2. Connect the long wire HD15 male connector of the Video Monitor Cable to the HD15 female port ofthe CPU.

3. Connect the short wire HD15 female connector of the Video Monitor Cable to the HD15 male connector of the video monitor.
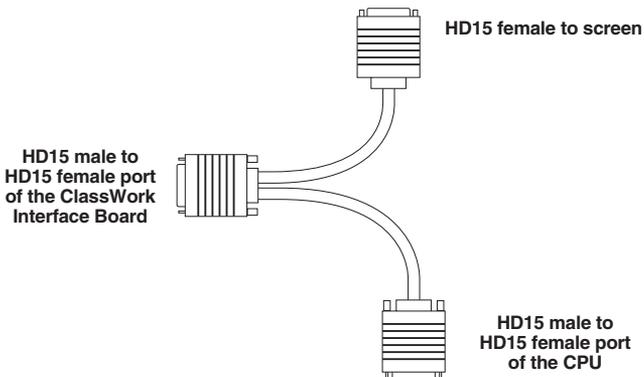
HD15 female to screen

HD15 male to HD15 female port of the ClassWork Interface Board

HD15 male to HD15 female port of the CPU

Figure 4-5. Video Monitor Cable.

4.5.6 CONNECTING THE SYSTEM CABLE ADAPTER AND THE SYSTEM CABLES

The System Cable Adapter is used to daisy-chain all student positions (CPUs) into one loop. This is done by connecting the System Cable Adapter to the ClassWork Plus Interface Board of each position. The other end of the System Cable Adapter is connected to the System Cable(s). The System Cable(s) runs from one System Cable Adapter in the daisy-chain to the two adjoining System Cable Adapters in the daisy-chain (see **Figures 4-6**, **4-7**, and **4-8**).

Connect the System Cable Adapter and the System Cables as follows:

1. Connect the DB15 male connector of the System Cable Adapter to the DB15 female port of the ClassWork Plus Interface Board.

2. Connect the DB25 female connector of the System Cable Adapter to the DB25 male connector(s) of the adjoining System Cable(s).
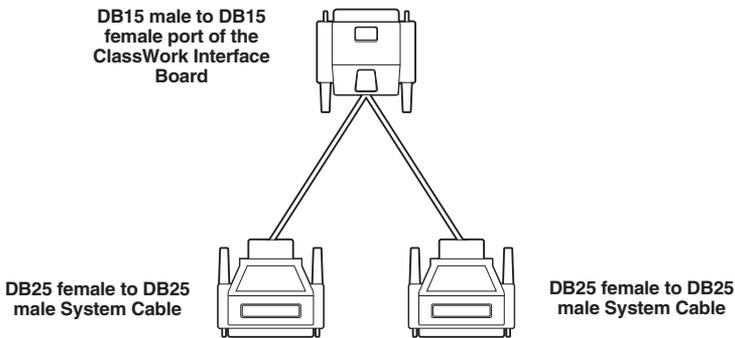
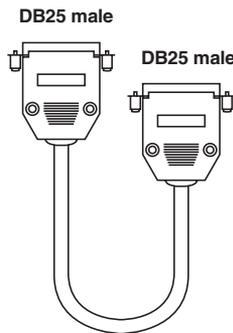**DB15 male to DB15 female port of the ClassWork Interface Board**

DB25 female to DB25 male System Cable

DB25 female to DB25 male System Cable

Figure 4-6. System Cable Adapter.

DB25 male

DB25 male

Figure 4-7. System Cable.

System Cable(s)

System Cable
Adapter

ClassWork
Interface
Board

Student's CPU

ClassWork
Interface
Board

Student's CPU
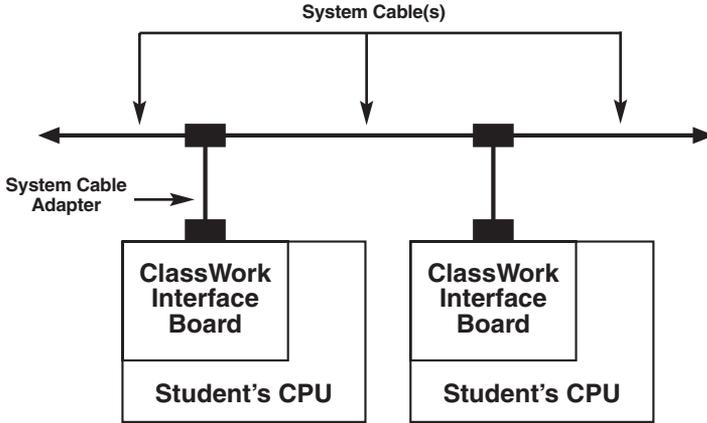
Figure 4-8. System Cable Adapter Connections.

The systems are connected as follows:

5-pin DIN male to 5-pin DIN
female keyboard port of CPU

To 8-pin mini-DIN female
port of ClassWork Plus
Interface Board

DIN5
female

DB9 female to mouse
port of CPU

DB9 male

HD15 male to HD15
female port of ClassWork
Plus Interface Board

HD15
female

HD15 male to HD15
female port of CPU

DB25 female
to System
Cable

DB25 female
to System
Cable

DB15 male to DB15
female port of ClassWork
Plus Interface Board

System Cable Adapter

Figure 4-9. Cable Diagram for AT Mouse Connections.

6-pin mini-DIN male to 6-pin mini-DIN female keyboard port of CPU

6-pin mini-DIN female

8-pin mini-DIN male to 8-pin mini-DIN female port of ClassWork Plus Interface Board

6-pin mini-DIN male to 6-pin mini-DIN female mouse port of CPU

HD15 female

HD15 male to HD15 female port of ClassWork Plus Interface Board

HD15 male to HD15 female port of CPU

DB25 female to System Cable

DB25 female to System Cable

DB15 male to DB15 female port of ClassWork Plus Interface Board
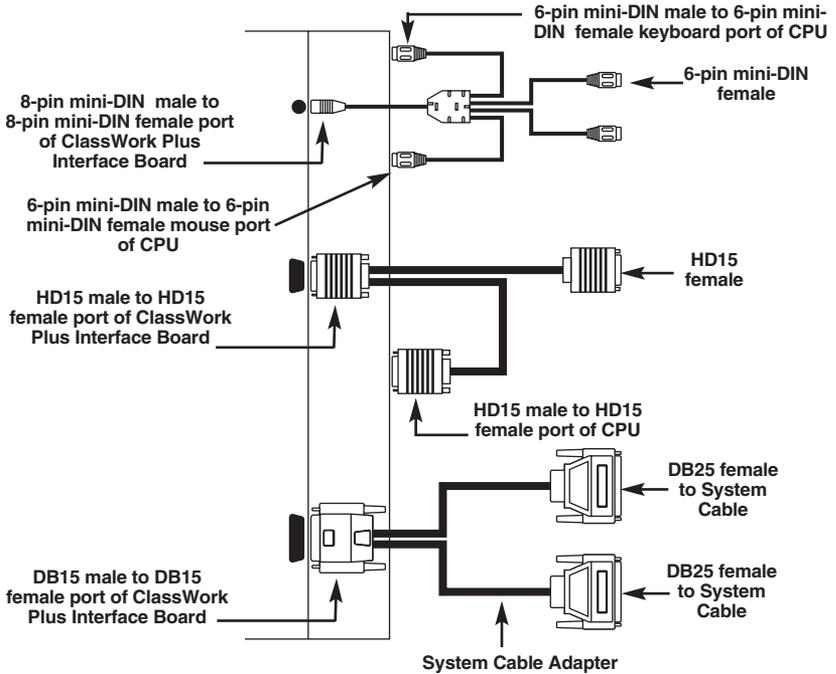
System Cable Adapter

Figure 4-10. Cable Diagram for PS/2 Connections.

When you've made all of the above connections, the student position is ready.

4.6 Connecting the Teacher Position

You can connect the teacher position in two different configurations. These configurations depend on whether the teacher is using the Teacher Control Unit or the ClassWork Plus Control Software to control the ClassWork Plus Board Version system.

4.6.1 TEACHER CONTROL UNIT CONFIGURATION

This section explains how to connect the hardware required to operate the teacher position when using the Teacher Control Unit to control the ClassWork Plus Board Version system. The teacher position consists of the teacher's computer plus the hardware required to hook it up.

4.6.2 TEACHER POSITION COMPONENTS

The teacher position consists of the following components:

- ClassWork Plus Interface Board

- I/O PC/AT and I/O PS/2 Adapter

- Control/System Cable Adapter

- Video Control "Y" Cable

- Control Cable

- Teacher Control Unit

- 2 Terminators

- Power Supply 9 VAC

4.6.3 INSTALLING THE BOARD

Take the following pre-installation precautions before hooking up the teacher's position.

1. Turn OFF and unplug the CPU.

2. Unplug the screen, keyboard, and mouse from the back of the CPU.

3. Open the cover of the CPU to expose the inside components.

4. In the back of the CPU, choose a free ISA slot in which to install the ClassWork Plus Interface Board.

5. Remove the bracket from the chosen slot. (Save the screw.)

6. Set the DIP switch on the ClassWork Plus Interface Board to "0."

7. Set the jumpers on the ClassWork Plus Interface Board for either PS/2 or PC/AT (these procedures are explained in **Section 4.4**.

8. Insert the ClassWork Plus Interface Board into the chosen slot and screw it in.

9. Close the cover of the CPU.

4.6.4 SETTING THE CLASSWORK PLUS INTERFACE BOARD

The ClassWork Plus Interface Board can be installed in a CPU that uses either a serial mouse and AT keyboard or a PS/2 mouse and keyboard.

Jumpers are used to select the operation modes for your Mouse. To set a jumper, a black cap containing metal contacts is clipped onto the jumper terminal pins, covering them. This action is known as shorting or closing. Jumper terminal pins left uncovered are referred to as open.

On the ClassWork Plus Interface Board where each jumper shorts two pins, shorting pin 2 and pin 3, for example, creates one setting, whereas shorting pin 1 and pin 2 would create another. You set the ClassWork Plus Interface Board to work in the AT Mouse format, by shorting Pin # 2 and Pin # 3, for JP4, JP3, JP2, and JP1, as Figure A.1 illustrates. JP5 is open.
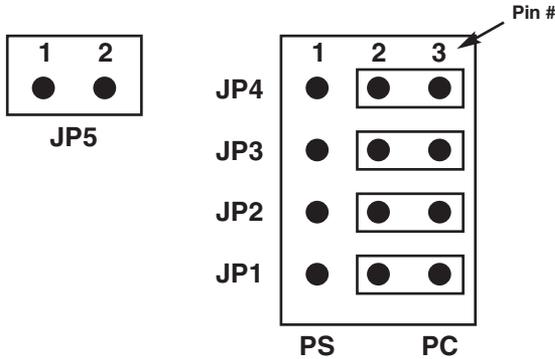
Figure 4-11. Jumper Settings for AT Mouse.

You set the ClassWork Plus Interface Board to work in the PS/2 format, by shorting Pin # 1 and Pin # 2, for JP4, JP3, JP2, and JP1, as Figure A.2 illustrates. JP5 is shorted.
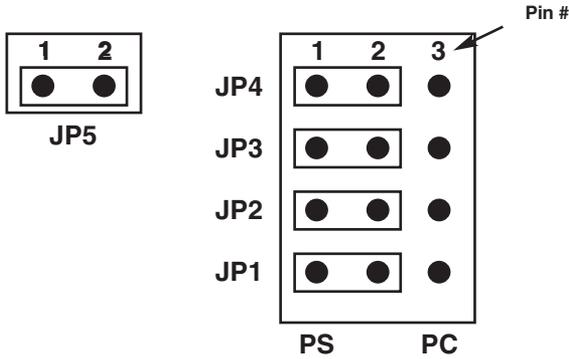
Figure 4-12. Jumper Settings for PS/2 Mouse.

4.6.5 CONNECTING THE CABLES

This section deals with the wiring of the different cables you'll need to connect the teacher's position.

This section will detail the connection of each cable individually.

Connecting the I/O Adapter

This section discusses connecting the teacher's screen, keyboard, and mouse to the teacher's position.

If the teacher is using an AT keyboard and mouse, do the following to connect the AT I/O Adapter (see **Figure 4-13**).

1. Connect the 8-pin mini-DIN male connector of the I/O Adapter to the 8-pin mini-DIN female port of the ClassWork Interface Board.

2. Connect the DB9 female mouse connector of the I/O Adapter to the DB9 male mouse port of the CPU.

3. Connect the mouse to the DB9 male mouse connector of the I/O Adapter.

4. Connect the 5-pin DIN male keyboard connector of the I/O Adapter to the DIN 5 female keyboard port of the CPU.

5. Connect the keyboard to the 5-pin DIN female keyboard connector of the I/O Adapter.
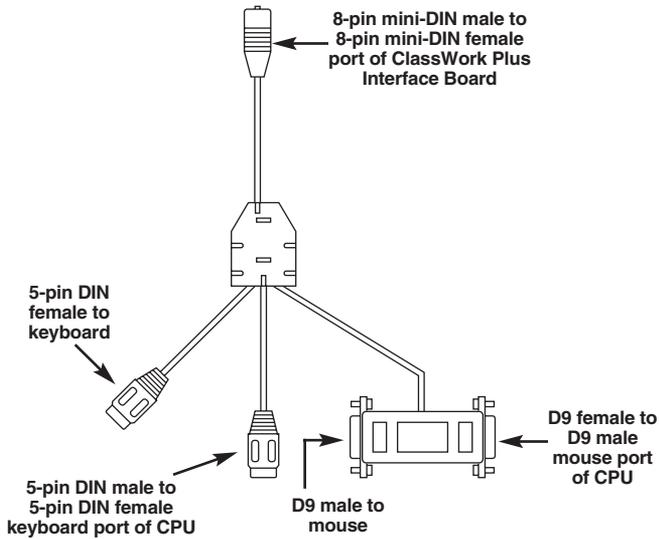
**8-pin mini-DIN male to
8-pin mini-DIN female
port of ClassWork Plus
Interface Board**

**5-pin DIN
female to
keyboard**

**5-pin DIN male to
5-pin DIN female
keyboard port of CPU**

**D9 male to
mouse**

**D9 female to
D9 male
mouse port
of CPU**

Figure 4-13. I/O Adapter for AT Mouse.

If the teacher is using a PS/2 keyboard and mouse do the following to connect the PS/2 I/O Adapter (see **Figure 4-14**):

1. Connect the 8-pin mini-DIN male connector of the I/O Adapter to the 8-pin mini-DIN female port of the ClassWork Plus Interface Board.

CAUTION

Do not confuse the 6-pin mini-DIN mouse connector with the 6-pin mini-DIN keyboard connector of the I/O Adapter. Each connector is specifically marked as to its purpose.

2. Connect the 6-pin mini-DIN male mouse connector of the I/O Adapter to the 6-pin mini-DIN female mouse port of the CPU.

3. Connect the mouse to the 6-pin mini-DIN female mouse connector of the I/O Adapter.

4. Connect the 6-pin mini-DIN male keyboard connector of the I/O Adapter to the 6-pin mini-DIN female keyboard port of the CPU.

5. Connect the keyboard to the 6-pin mini-DIN female keyboard connector of the I/O Adapter.
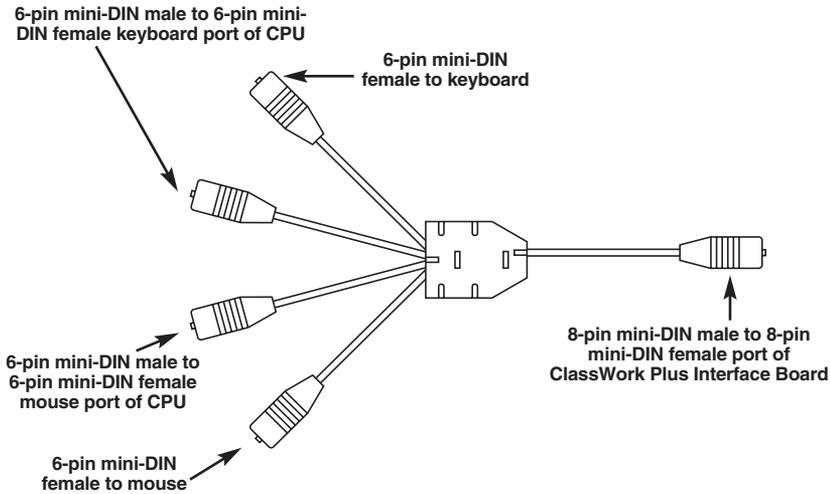
6-pin mini-DIN male to 6-pin mini-DIN female keyboard port of CPU

6-pin mini-DIN female to keyboard

8-pin mini-DIN male to 8-pin mini-DIN female port of ClassWork Plus Interface Board

6-pin mini-DIN male to 6-pin mini-DIN female mouse port of CPU

6-pin mini-DIN female to mouse

Figure 4-14. I/O Adapter for PS/2.

4.6.6 CONNECTING THE VIDEO CABLE

To connect the Video Monitor Cable:

1. Connect the HD15 male connector of the Video Monitor Cable to the HD15 female port of the ClassWork Plus Interface Board.

2. Connect the long-wire HD15 male connector of the Video Monitor Cable to the HD15 female port of the CPU.

3. Connect the short-wire HD15 female connector of the Video Monitor Cable to the HD15 male connector of the video monitor.

HD15 female to screen

HD15 male to
HD15 female port
of the ClassWork
Interface Board

HD15 male to
HD15 female port
of the CPU
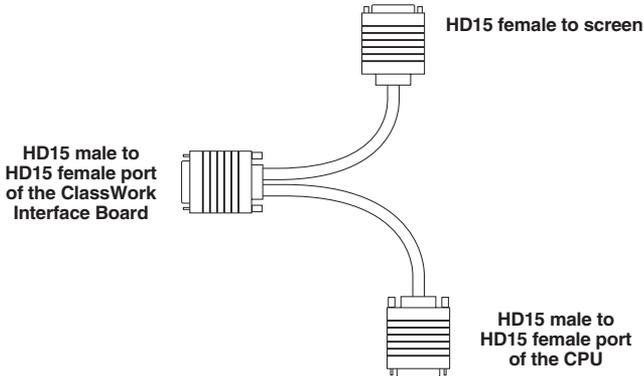
Figure 4-15. Video Monitor Cable.

4.6.7 CONNECTING THE CONTROL/SYSTEM CABLE ADAPTER

The Control/System Cable Adapter is used to connect the ClassWork Plus
Interface Board to the Teacher Control Unit and the two adjoining student CPUs
within the daisy-chain loop (see **Figures 4-16**, **4-17**, and **4-18**).

NOTE

**The daisy-chain loop is made by connecting all adjoining student
System Cable Adapters via the System Cables (see Section 4.6.8).**

Connect the Control/System Cable Adapter as follows:

1. Connect the DB15 male connector of the Control/System Cable Adapter to
    the DB15 female port of the ClassWork Plus Interface Board.

2. Connect the DB25 female connector of the Control/System Cable Adapter to
    the DB25 male connector(s) of the adjoining System Cable(s).

3. Connect the 5-pin DIN male connector of the Control/System Cable Adapter
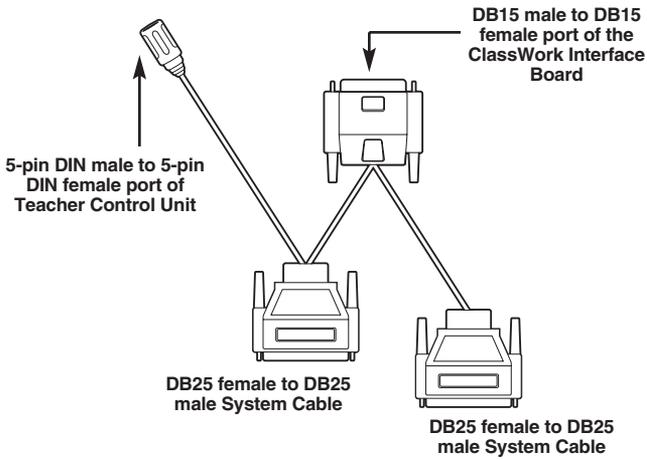   to the 5-pin DIN female port of the Teacher Control Unit.

DB15 male to DB15 female port of the ClassWork Interface Board

5-pin DIN male to 5-pin DIN female port of Teacher Control Unit

DB25 female to DB25 male System Cable

DB25 female to DB25 male System Cable

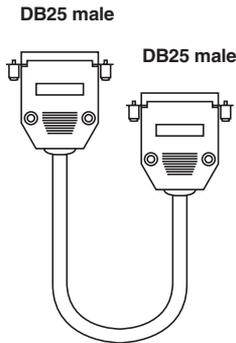**Figure 4-16. Control System Cable.**

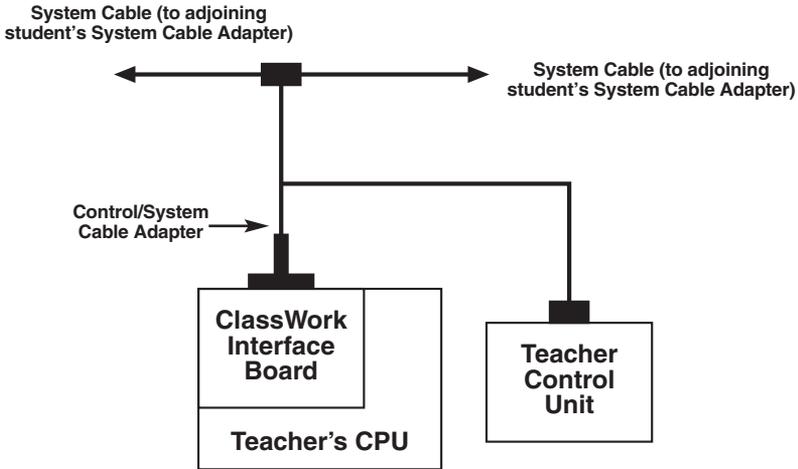**DB25 male**

DB25 male

Figure 4-17. System Cable.

Figure 4-18. Control/System Cable Adapter Connections.

4.6.8 CONNECTING THE SYSTEM CABLE(S)

The System Cables are used to daisychain all positions into one loop. This is done by connecting two System Cables to the DB25 female connector of the Control/System Cable Adapter. The other ends of the System Cables are comlected to the DB25 female connectors of the adjoining students' System Cable Adapters.

In order to connect the System Cables do the following (see **Figures 4-17** and **4-19**):

1. Connect the DB25 male connector of the System Cable to one of the DB25 female connectors of the Control/System Cable Adapter.

2. Connect the other DB25 male connector of the System Cable to the DB25 female connector of the System Cable Adapter of adjoining student's position.
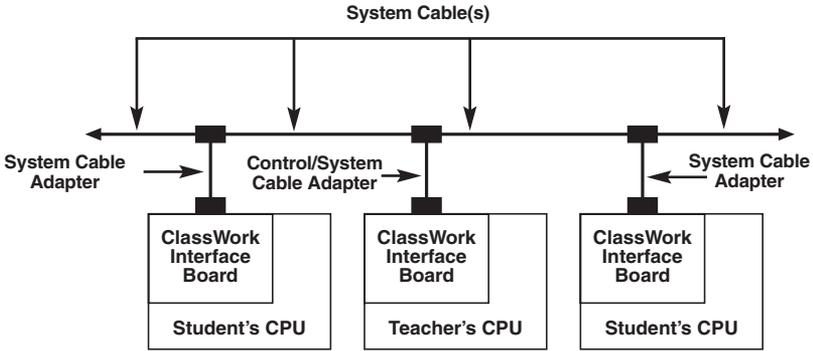
Figure 4-19. System Cable Connections.
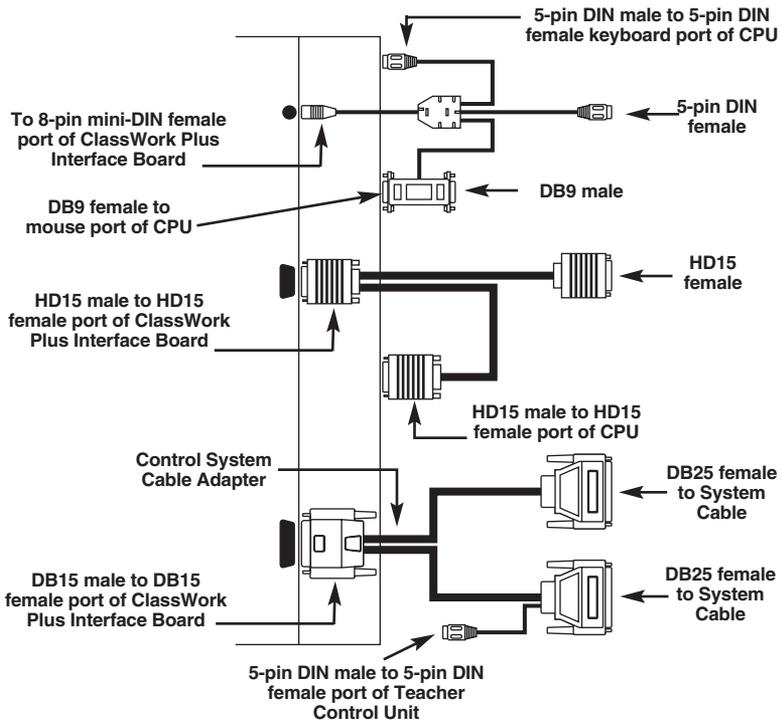
The systems are connected as follows:
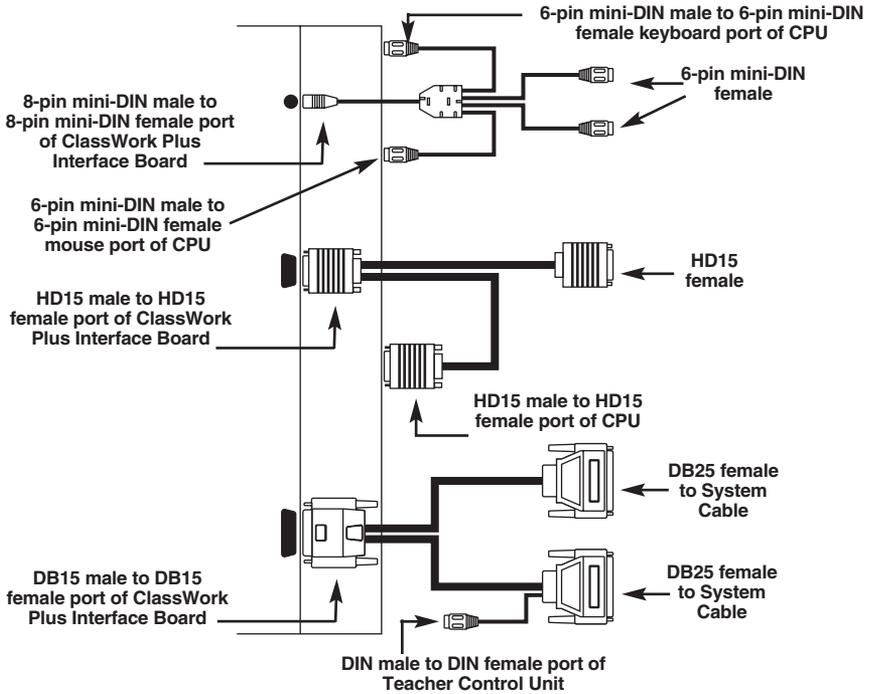
**Figure 4-20. Cable Diagram for AT Mouse Connections.**

6-pin mini-DIN male to 6-pin mini-DIN female keyboard port of CPU

6-pin mini-DIN female

8-pin mini-DIN male to 8-pin mini-DIN female port of ClassWork Plus Interface Board

6-pin mini-DIN male to 6-pin mini-DIN female mouse port of CPU

HD15 female

HD15 male to HD15 female port of ClassWork Plus Interface Board

HD15 male to HD15 female port of CPU

DB25 female to System Cable

DB25 female to System Cable

DB15 male to DB15 female port of ClassWork Plus Interface Board

DIN male to DIN female port of Teacher Control Unit

Figure 4-21. Cable Diagram for PS/2 Connections.

4.6.9 CONNECTING THE TERMINATORS

Connect the Terminators to the DB25 connectors of the System Cable Adapetr(s) (or the Control/System Cable Adapter) at the two ends of the daisy-chain loop (see **Figure 4-22**).

DB25 male
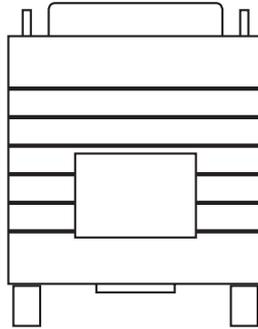
Figure 4-22. Terminator.

4.6.10 CONNECTING THE POWER SUPPLY

Insert the power-supply plug into the power port on the rear of the Teacher Control Unit, and plug the cord into a wall socket (see **Figure 4-23**).
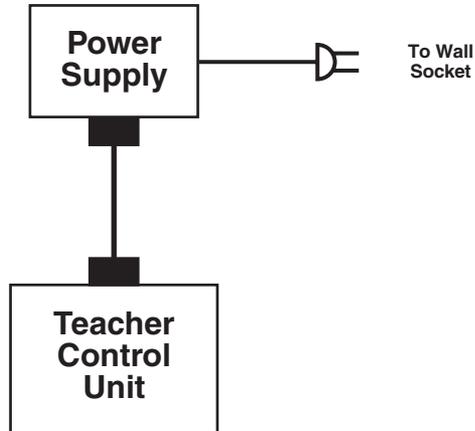
Figure 4-23. Power-Supply Connections.

When all of the above connections have been made, the ClassWork Plus Board is ready for use.

5. Operating ClassWork Plus

5.1 Setup

1. Turn on all the Student Units and then turn on the computers. (The OK LED in the Student Unit will be lit.)

2. Turn on the Instructor Interface Unit and then turn on the instructor computer. (The function display at the Instructor Control Unit will show function names.)

3. Press the RESET button at the rear of the Instructor Control Unit.

The system is now activated.

5.2 Using the Instructor Control Unit

The Instructor Control Unit consists of a function display and a dedicated keyboard.

Every student in the system is allocated a two-digit number from 01 to 63. The system manages up to 10 groups appearing as GROUP 0 to GROUP 9. Four MACRO keys appear as F1 to F4. The instructor station is named MASTER.

All functions are activated by using the keyboard. The appropriate indication will appear on the display.
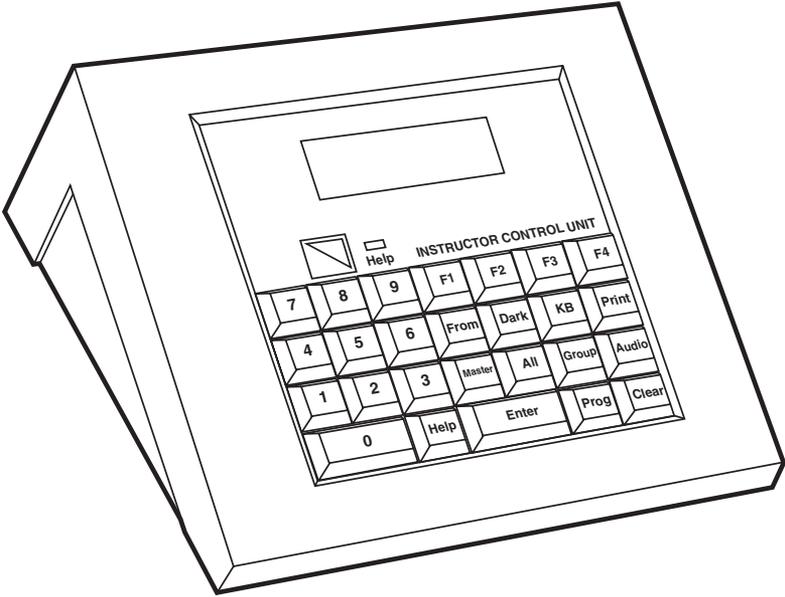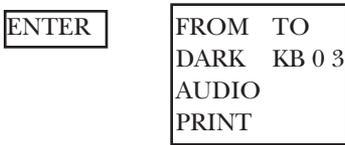
Fig. 5-1. Instructor Control Unit.

Pressing a function key activates the cursor:

```
KB          FROM  TO
            DARK  KB
            AUDIO
            PRINT
```

Press the Student Unit number (always two digits):

```
0     3     FROM  TO
            DARK    KB 0
            AUDIO
            PRINT
```

Press ENTER to confirm:

```
ENTER       FROM  TO
            DARK    KB 0 3
            AUDIO
            PRINT
```

The function is now activated.

Fig. 5-2. Example.

To cancel a function (once activated), press that function key again.

To cancel the last step before the function is activated by pressing ENTER, press CLEAR.

An incorrect command is indicated by a flashing E. To correct it, press the correct command. To escape, press CLEAR.

5.3 Selecting a Group

The system stores up to 10 groups. Group #8 always contains the ODD numbers, and group #9 contains the EVEN numbers. You can set all other groups as follows:

Example

Define group #0:

GROUP 0 ENTER

The Instructor Control Unit screen will show:

GROUP 0

Select the stations you want to include in this group by pressing their 2-digit number. Press ENTER to confirm, or CLEAR to cancel.

Attention

To erase the last number entered, press CLEAR once. The second CLEAR command will erase the entire group.

Group selection is stored in the system even if you turn it off.

5.4 Using MACRO Keys

The MACRO keys allow the instructors to activate their most-used functions by using one keystroke.

The MACRO keys are programmed by default to the following functions:

F1: FROM MASTER TO ALL

F2: DARK ALL
F3: PRINT ALL
F4: AUDIO ALL

You can program these MACRO keys to any other function.

Example:

To program F1 as KB ALL, press:

PROG F1 KB ALL ENTER PROG

F1 key is stored now as KB ALL function.

5.5 Reset

To reset the system, press the toggle RESET switch on the rear of the Instructor Control Unit.

5.6 Functions

5.6.1 FROM...TO
Display a screen to the entire class, or to chosen student units or groups.

Examples:
 FROM 10 TO MASTER ENTER
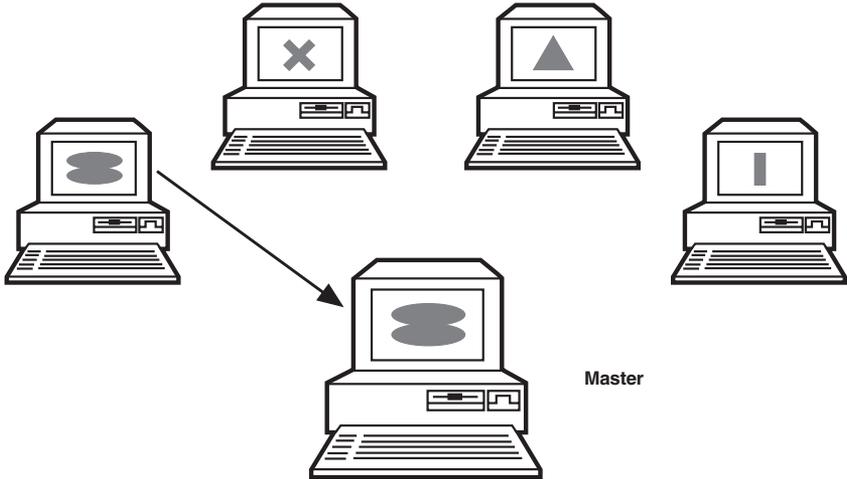
Fig. 5-3. Display student's screen on the instructor's screen.
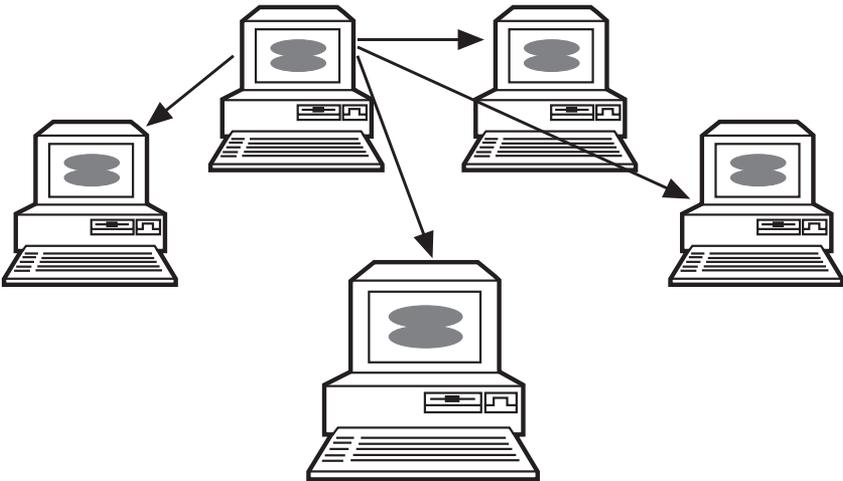
FROM 06 TO ALL ENTER

Fig. 5-4. Display student's screen to the entire class.
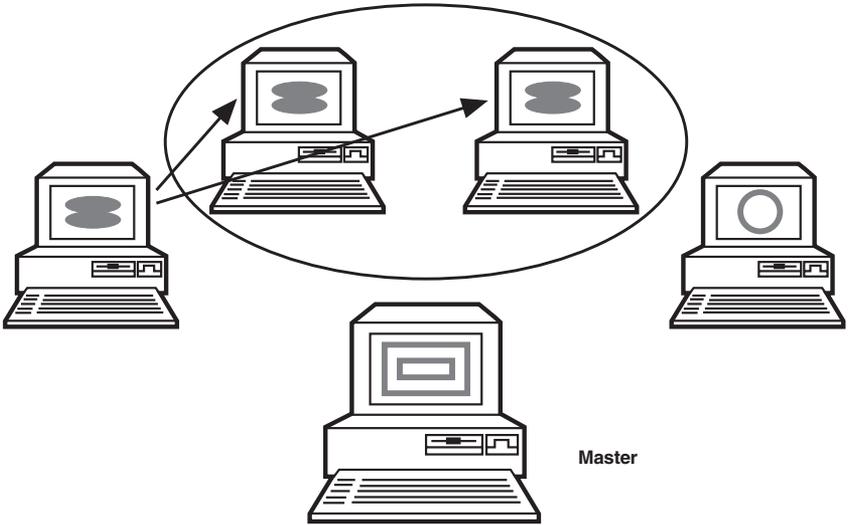
FROM 12 TO GROUP 3 ENTER

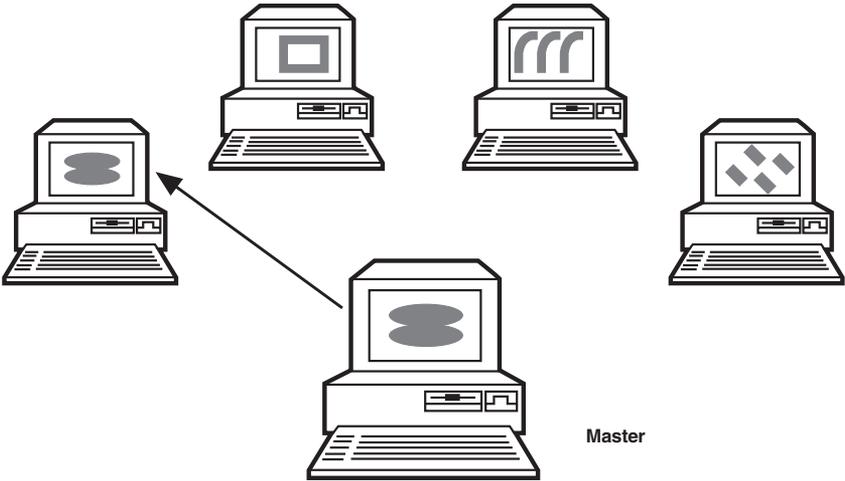**Fig. 5-5. Display a student's screen to group #3.**

FROM MASTER TO 24 ENTER

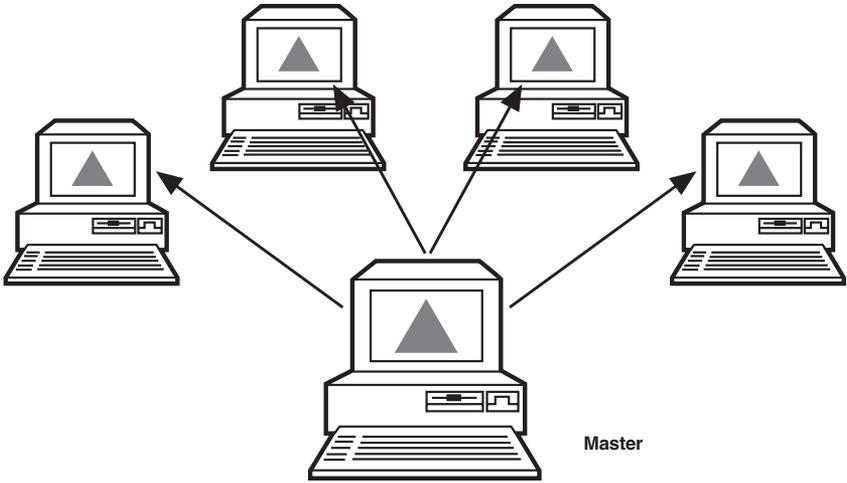**Fig. 5-6. Display instructor's screen to a student.**

FROM MASTER TO ALL ENTER

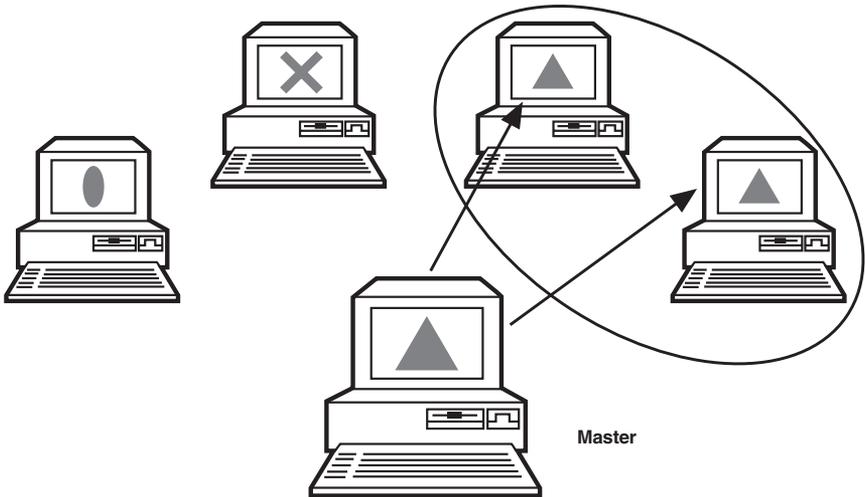**Fig. 5-7. Display instructor's screen to the entire class.**

FROM MASTER TO GROUP 6 ENTER
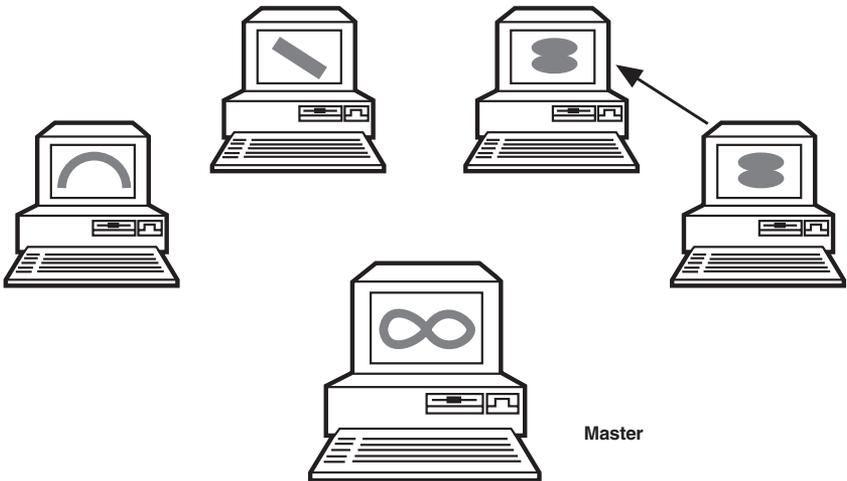

Fig. 5-8. Display instructor's screen to group #6.

FROM 25 TO 36 ENTER

Master

Fig. 5-9. Display a student's screen to another student.

5.6.2 SCANNING

Display all student screens, or part of them, sequentially on the instructor screen. Each screen appears for 30 seconds. To change this default time, enter a new value (01 to 99 seconds) before pressing ENTER.
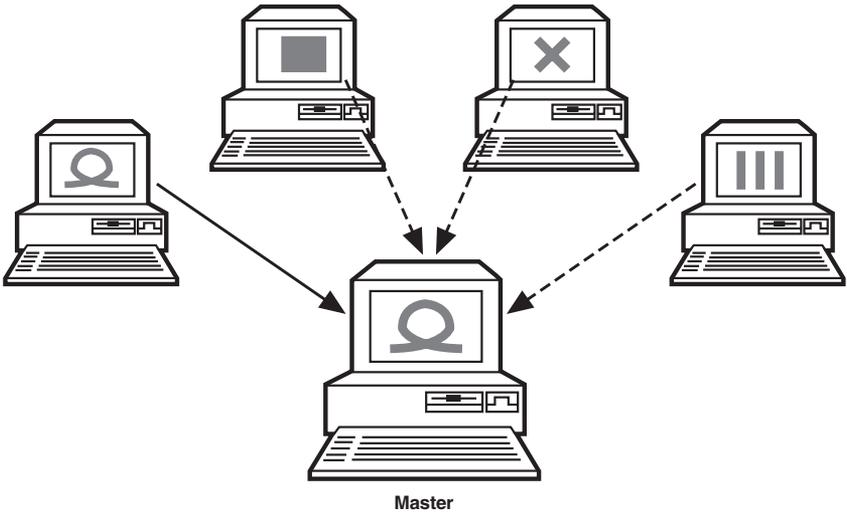
Examples:

FROM ALL TO MASTER 45 ENTER

Master

Fig. 5-10. Display all students' screens sequentially on the instructor's screen for 45 seconds each.

NOTES

The student station number currently shown on the instructor's screen flashes on the right side of the FROM...TO function as follows:

FROM ALL TO MASTER 01

Two seconds before continuing to the next screen, the entire line will flash. Press ENTER to remain at the current screen (student station number stops flashing).

Press ENTER again to continue scanning (student station number starts blinking again).
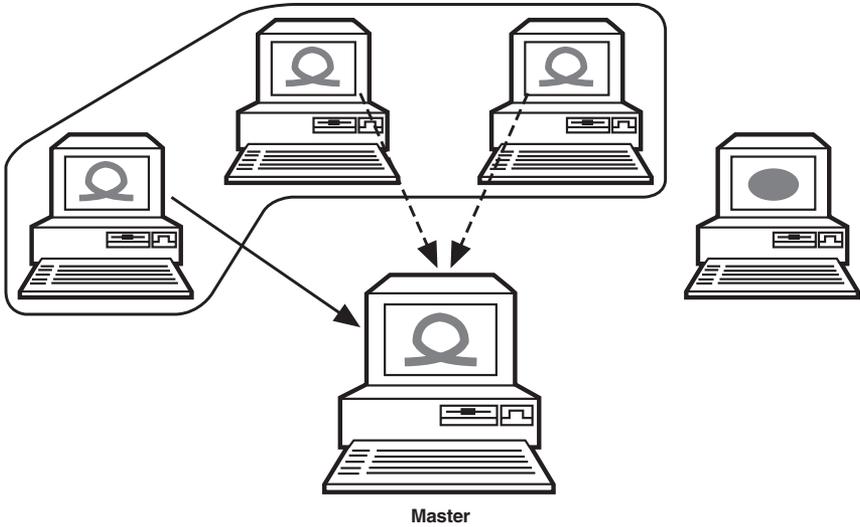
FROM GROUP 4 TO MASTER ENTER

Master

Fig. 5-11. Display Group #4 screens sequentially on the instructor's screen for 30 seconds each.

NOTES

The student station number currently shown on the instructor's screen flashes on the right side of the FROM...TO function as follows:

FROM GROUP 4 TO MASTER 01

Two seconds before continuing to the next screen, the entire line will flash. Press ENTER to remain at the current screen (student station number stops flashing).

Press ENTER again to continue scanning (student station number starts blinking again).

5.6.3 DARK

Interrupts all of the students, or part of them, by darkening their screens and disconnecting their keyboards and mice.
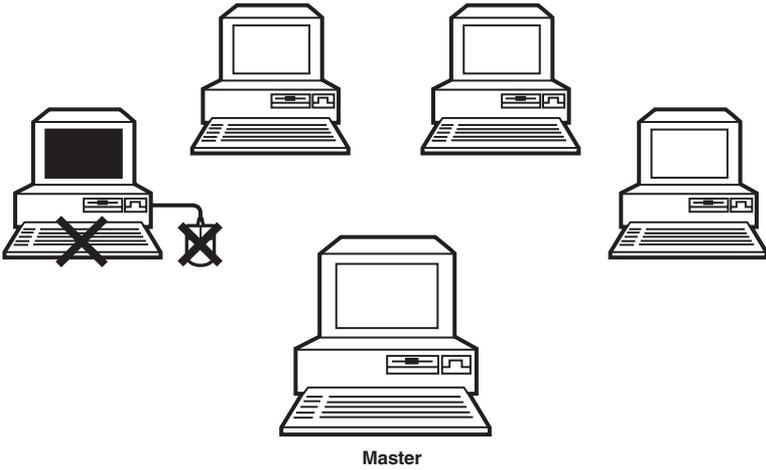
Examples:

DARK 13 ENTER

Master

Fig. 5-12. Interrupt one student.
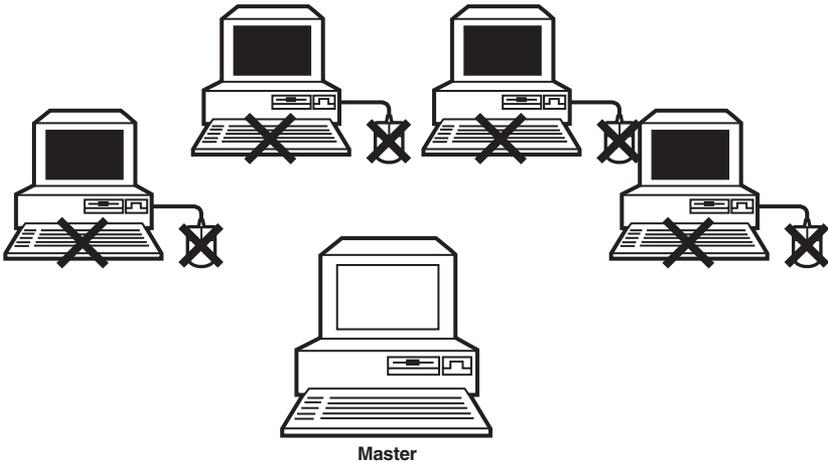
DARK ALL ENTER

Master

Fig. 5-13. Interrupt all students.
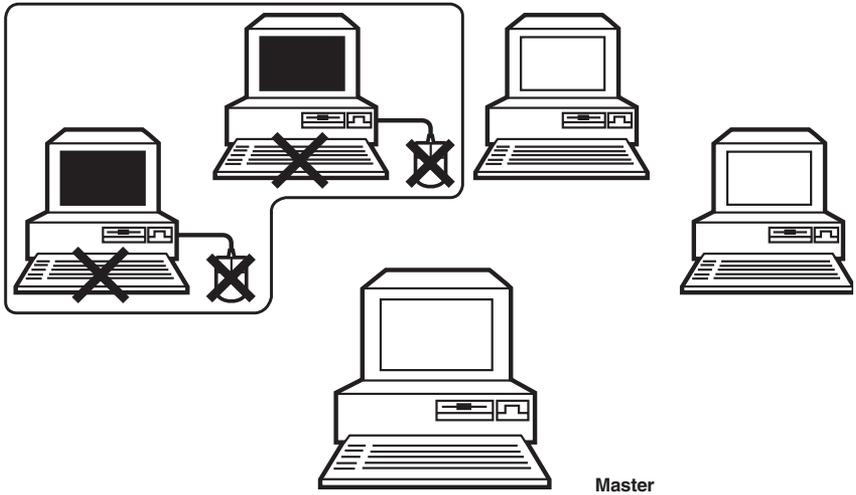
DARK GROUP 7 ENTER

Fig. 5-14. Interrupt group 7.

5.6.4 KB

Control of keyboard and mouse of one station is given to another station. The station that receives the control shows the controlled computer's screen.
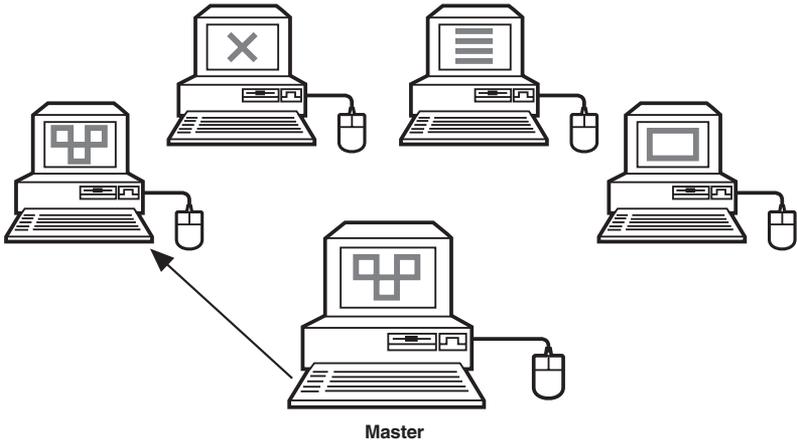
Examples:

KB 21 ENTER

Fig. 5-15. Give the instructor control over student #21's computer.
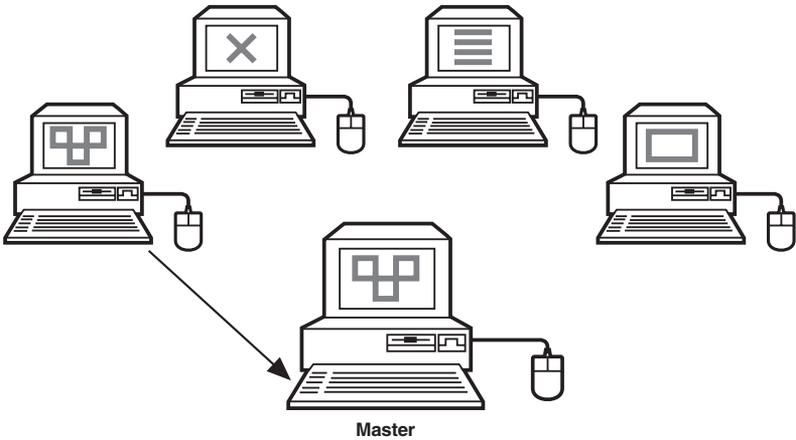
KB MASTER 56 ENTER

Fig. 5-16. Give student #56 control over the instructor's computer.
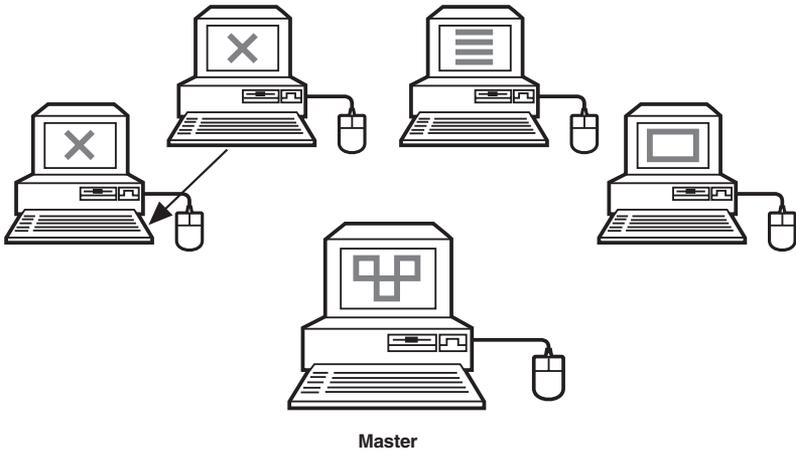
KB 05 12 ENTER

Master

Fig. 5-17. Give student #12 control over student #05's computer.

5.6.5 KB ALL

KB ALL allows the instructor to gain remote control of all student keyboards and mice sequentially.

Examples:

KB ALL ENTER

The instructor has control over station number 1. The number of the station that is controlled appears on the Instructor Control Unit display.
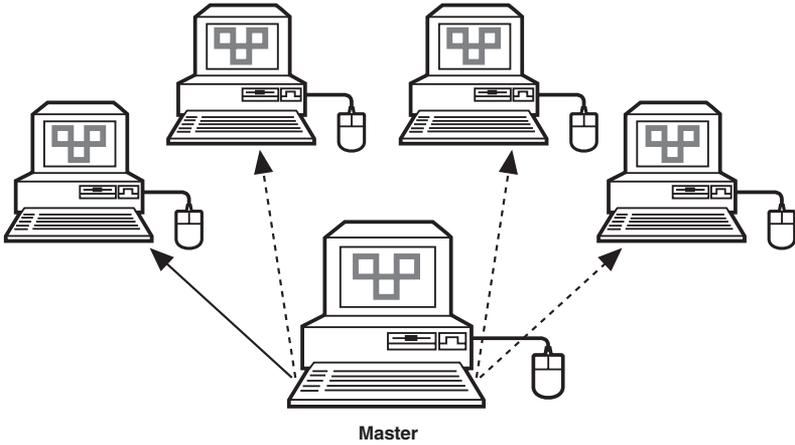
KB ALL 01

Master

Fig. 5-18. KB ALL ENTER.

To continue to the next station, press ENTER on the Instructor Control Unit keyboard.
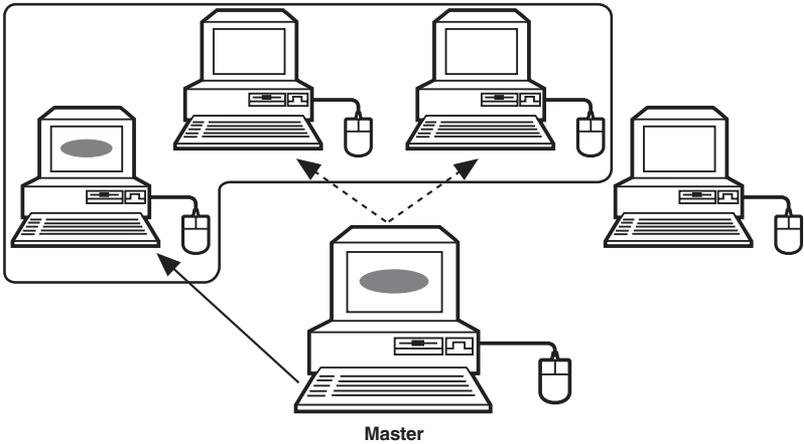
KB GROUP 2 ENTER

Master

Fig. 5-19. Gain control over group #2.

The instructor has control of the first station in the group. The number of the station that is controlled appears on the Instructor Control Unit display.

KB GROUP 2 01

To continue to the next station, press ENTER on the Instructor Control Unit keyboard.

5.6.6 HELP

HELP indicates to the instructor that a student is calling for assistance (up to 7 calls can be shown at a time).

A student activates this function by pressing the HELP button on the front panel of his Student Interface Unit. The call is indicated on the Instructor Control Unit by the red HELP LED. The HELP LED is lit at the Student Unit.

To review a list of students who called for help, press the HELP button, and the station numbers will be shown on the Instructor Control Unit display as shown in **Fig. 4-20**.

```
            HELP !!!          HELP!!!

    12      15      23




    PRESS HELP TO ESCAPE
```
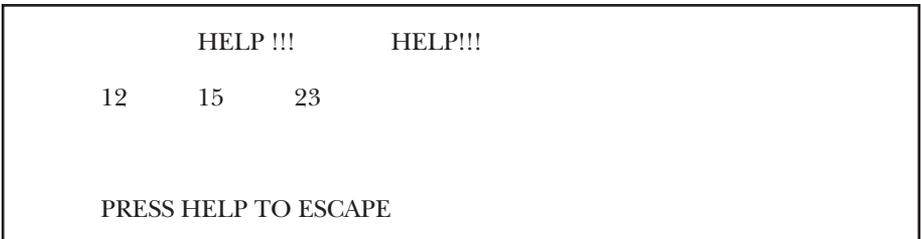
Fig. 4-20. Help Screen.

To clear a call, press CLEAR followed by the student number:

CLEAR 23

To erase all calls press:

CLEAR ALL

5.6.7 LINKS AND PRIORITIES
- DARK function has priority over all other functions.

- HELP can be operated simultaneously with all other functions.

- KB and FROM...TO can be activated together, but only when they are activated on the same student.

Examples:

FROM 07 TO ALL
KB 07

or

FROM ALL TO MASTER 15
KB 15

NOTE

For this last combination, the scanning is interrupted until the KB function is released.

5.7 Operating Student Interface Unit

5.7.1 OK INDICATOR

Turning ON the student computer connects the student to the system. The OK indicator is lit.

5.7.2 WAIT INDICATOR

When the student is interrupted by the system (by the DARK or KB functions), the WAIT indicator lights.

5.7.3 HELP FUNCTION

For help, press the HELP button. The HELP indicator lights when the call is received.

Appendix: Environmental Requirements

This appendix contains a list of the pre-installation environmental requirements of the ClassWork Plus system.

A.1 Electrical Connections

ClassWork Plus Board Version connects the instructor's computer with up to 63 student computers, providing the instructor with control over the interconnection of the keyboard, mouse, and monitor screen of each student. The ClassWork Plus Interface Board acts as an intermediary between the student's computer and these peripheral devices. When ClassWork Plus is configured to route each student's peripherals to that student's computer, the student should be able to work as though ClassWork Plus were absent and the peripherals were connected directly to the computer—without loss of quality.

These peripheral devices were designed to be connected by short cables directly to the computer, in order to minimize the effects of external sources of noise and interference, and to insure that signals are exchanged with minimal loss of strength. By inserting the ClassWork Plus Interface Board between the computer and the peripherals, some noise will be introduced and some signal strength will be lost at the connection. Since the ClassWork Plus system amplifies and transmits these signals among all the Interface Boards, this added noise will be amplified along with the signals to be exchanged between the computer and the peripherals. To avoid serious loss of quality, the connections among the components of the ClassWork Plus installation must be made in the best possible manner in order to keep the signal degradation from accumulating and being amplified.

A.2 Power and Ground

An electrical power supply may provide either direct current (DC) or alternating current (AC) and may operate at a variety of voltage levels. The output of any power supply is provided as either two or three contacts, which are properly referred to

- Live (or Hot)

- Neutral (or Return)

- Earth

The output voltage of the supply is the voltage difference between the Neutral contact and the Live contact. The current provided by the power supply flows between these contacts.

Under normal use, no current flows between Earth and the other contacts. The Earth contact is fixed at the voltage of the environment (ground, floor, tables, etc.), so that contact with equipment properly connected to Earth poses no danger of electric shock. On low voltage DC power supplies, the Earth contact is generally omitted.

In most buildings, AC power is distributed in branches. Each branch is protected by a separate circuit breaker or fuse, and provides power to the electrical outlets on that branch. At the circuit breaker, Neutral and Earth are connected in common through a heavy conductor to the ground.

Both the Neutral and Earth contacts of a power supply are sometimes called Ground, which can lead to confusion. In electronic circuits, Ground is the common reference point for the measurement of voltages at various points in the circuit— "the voltage" at a point is the voltage difference between that point and ground.

In a ClassWork Plus installation, make sure that all computers are connected to outlets on the same circuit branch, because:

- The Earth connection is used as a shield against external noise and interference which may adversely affect the quality of the image transferred among the computers on the network. A common Earth connection among all equipment connected to ClassWork Plus is required for this shielding to be effective.

- The Neutral connection provides the Ground signal which is the common reference against which all other signal levels are measured. When equipment is powered by multiple electrical branches, the reference voltage will not be uniform throughout the system and the image quality will be impaired.

- The frequency and phase of the AC power are used as the timing reference for the images on the screen. When equipment is powered by multiple electrical branches, small variations in phase between different branches can lead to synchronization problems and serious deterioration in image quality.

Typical problems which may be caused by multiple electric power branches are:

- Signal Loss—No image on a monitor.

- "Ghosts"—A second faint monitor image appears on the screen, usually to the right of the main image.

- Delayed Sync—Rolling of the screen image caused by a mismatch in the vertical synchronization timing.

- Voltage Spikes—Sudden jumps in the supply voltage which can damage equipment and cause injury.

A.3 Connectors

A connector between electronic circuits or subsystems may carry several signals which share a common Ground (and the Ground itself), or it may carry individual Ground connections (Signal Return) for each signal. In addition, the connector may provide a proper Earth ground for protection of the equipment and the user. The Earth ground also provides a shield against external noise and interference which may adversely affect the quality of the image transferred among the computers on the network.

In a ClassWork Plus installation, the connectors among all equipment must be of the appropriate type, in good physical condition, and properly attached. Problems caused by poor connections include:

- Signal Loss—No image on a monitor.

- Signal Degradation—Poor image quality, distortion of the image, and noisy image ("snow").

- Spurious Data—The data arriving at a computer contains errors, loss of data, or spurious characters.

- Equipment Damage—In extreme cases, a poor connection may lead to inappropriate voltages, spikes, or sparks entering a component, which may damage the component and pose danger of shock to the user.

- Radio Interference—Improper connection of the shield ground may cause one of the network components to become a source of electromagnetic interference (EMI), which can affect other equipment in the area.

Pay particular attention to the following problems caused by improper connections:

- Loose Connections—Broken or loose connectors, or connectors with bent or missing pins, can cause poor contact. Occasionally, loose connectors will cause problems which appear intermittently and will be difficult to locate.

- Screw Connectors—Connectors provided with tightening screws should be closed properly.

- Accessories—Connectors and accessories provided by third party vendors must provide proper connections for the transfer of all signal grounds and the shield ground.

- Power—The power must be turned off before connecting or disconnecting electronic equipment, unless explicitly permitted.

A.4 Static Electricity

Static electricity is generated on non-conducting surfaces such as paper, cloth, plastic, hair, and carpeting. Electrostatic discharge (ESD)—a small spark from a non-conductor—can cause damage to electronic equipment, even if the spark is too small to feel. In order to avoid damaging ESD, the following rules should be followed:

- Do not bring electronic circuit boards, components, or connectors into contact with non-conductors.

- Avoid contact between clothing and circuit boards, components, or connectors.

- Circuit boards and components are packed for shipping in special conductive plastic or on conductive foam. Keep loose circuit boards or components inside or on top of their protective wrapping.

- Do not touch the internal pins of connectors.

- Before touching a circuit board or component, touch an Earth ground (a cold water pipe or the metal frame of the computer) to discharge any static safely.

- When possible, use grounding straps attached to the wrists.

A.5 Air Quality

Classrooms may accumulate a certain amount of dust and litter, which can damage electronic equipment. To minimize problems:

- Keep food and beverages away from computers and associated equipment.

- Periodically clean dust from computers and associated equipment.

- Periodically clean the filters on air conditioners and heaters.

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