HomeVision-PC

Owner's Manual

Version 2.62

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<u>CONTENTS</u>

CHAPTER 1: INTRODUCTION

Welcome to HomeVision-PC and the exciting world of advanced home automation. HomeVision-PC provides many powerful, yet easy to use, features. Among these:

- Video output displays menus and control screens on your TV. You can even create your own screens to control your house or display messages.

- Infrared receive capability so you can control HomeVision-PC (and your whole house) from your own remote control.

- Infrared transmit capability to control TVs, stereos, etc.

- Two-way X-10 communication to control and monitor lights, appliances, thermostats, etc. Received X-10 signals can trigger events.

- 8 relay drivers outputs to drive external relays, solenoids, etc.

- 8 digital inputs for direct connection of switch closure type devices such as switches and relay contacts. Allows direct connections of most alarm sensors.

- 8 bi-directional I/O ports. As inputs, they can connect to switch closure devices. As outputs, they can drive 5V digital circuits, LEDs, etc.

- Whole-house control from your IBM-compatible computer over the serial interface (up to 19,200 baud).

HomeVision-PC must be connected to a computer to function (only the standard HomeVision version can run "standalone"). The supplied software configures the controller and allows you to directly send commands to it. However, you will probably want to use another computer program to actually control your home. Available programs include:

- HomAtion 2000
- MASS
- Home Voice
- HAL2000
- ECS
- ACE

You may also write your own software to control HomeVision-PC.

Manual Organization

This manual is organized as follows:

- This chapter provides an overview.

- Chapter 2 describes the PC software program and its many screens.

- Chapter 3 provides a "Quick Start" process to get the controller initially set up and checked out. It also serves as a brief demo of the controller's capabilities.

- Chapters 4 - 11 provide detailed information on each of HomeVision's "objects" and interfaces. Each chapter provides:

  - An overview
  - Descriptions of all available commands
  - Physical connection information (for input/output ports, video interface, etc.)
  - Details on how to use the objects
  - And more

- Chapter 12 provides trouble-shooting suggestions.

Checking For Updated Information

After installing the computer software (as described in chapter 2), please read the "ReadMe" and "NewInfo" files. They contain important information, as we are constantly adding new features which may not be covered in this manual.

On-Line Help

The help file provides context sensitive help information. From any screen in the PC software, press F1 (the function 1 key) or select the help menu. The help file is updated with each new software version, while this manual is updated less frequently.

Manual Conventions

Several conventions were used in writing this manual:

- The term "controller" is often used. This refers to the HomeVision-PC control unit itself, not the PC software.

- When we write "PC software" or "software", or "PC program", we're referring to the Window-based program running on your PC.

- "Schedule" refers to the disk file that contains all your settings and objects. This schedule must be loaded into the controller to take effect.

- Numeric format. Most of the data used by the controller is comprised of a single byte. Each byte contains 8 bits and can ranges in value between 0 and 255. Throughout this manual, values will be written in three different formats: decimal, hexadecimal, and binary. Suffixes will be used to indicate the format of a value, as described below:

FORMAT	SUFFIX	EXAMPLES
Decimal	d	0d, 4d, 47d, 255d (or 0, 4, 47, 255)
Hexadecimal	h	00h, 04h, 2Fh, FFh
Binary	b	00000000b, 00000100b, 00101111b, 11111111b

Notes

- Decimal values will often be written without the suffix. Any value without a suffix will always be decimal.

- Hexadecimal values are always written as 2 digits ranging from 00h to FFh.

Safety Tips

HomeVision-PC provides many features that can be used to control your home (or office, building, etc.). If used improperly, damage to your home, equipment, electronics, or other items could result. Be very careful in how you set up and use the controller. Custom Solutions, Inc. is not responsible for any damage or other consequences that may result from the use of HomeVision-PC.

- Lamp and appliance modules with polarized plugs must be used only with polarized wall outlets.

- Do not connect appliances or other devices that require a full 110V load to lamp modules. Lamp modules (or other devices with dimming capability) can damage such equipment (including TVs and stereos). Connect such devices to appliance modules only.

- Do not connect fluorescent lights to lamp modules or other devices with dimming capability, as damage may result.

- Do not use wall switches to control electrical outlets, as damage to plugged-in devices could result.

- Do not use wall switches to control fluorescent lights, as damage may result.

- Do not exceed the ratings of any device. This includes the controller's input and outputs, as well as external devices.

- Turn off power at the circuit breaker or fuse panel before working on electrical outlets.

- Remove power from the controller before opening unit.

- Take care when using the controller to control critical equipment such as security systems, air conditioning and heating units, water heaters, pool pumps, etc.

CHAPTER 2: SOFTWARE OVERVIEW

The supplied Windows software is used to configure the controller and create a schedule. It can also directly control many of the controller's functions. This chapter provides an overview of it's functions and screens.

Program Overview

Main Menu

The program's main menu contains the following entries:

- File

  From this menu, you can create new schedules, open existing ones, or save them. You can also load the schedule into the controller or print reports.

- Configure

  This menu is used to access a variety of controller and PC software settings.

- Objects

  This menu takes you to the summary screens for objects. Objects include X-10 modules, input ports, output ports, and infrared signals. These screens are used to create, view, and edit these items.

- Control

  This menu opens control screens that give you direct control of HomeVision-PC's functions. There are control screens for X-10, infrared signals, input/output ports, video functions, and some controller commands. To operate these, the controller must be connected to the serial port. Some of these also require that a schedule to be loaded in order to work, while others can be used without a loaded schedule.

- Other

  This menu provides access to miscellaneous screens that provide infrared signal learning and testing, status information, and other features.

- Help

  This menu provides access to the software help system. You can also access context-sensitive help by pressing the function 1 (F1) key from any screen.

Program Screen Descriptions

Most of the program's screens are self-explanatory and will not require much time to learn. This section provides a brief summary.

There are four main types of screens:

- Object summary screens
- Configuration screens
- Control screens
- Other screens

Object Summary Screens

These screens are used to create, view, and edit objects. They are accessed with the pull-down menu "Objects". There are separate screens for each of the following items:

- X-10 Modules
- Input Ports
- Output Ports
- Infrared Signals

Common Features

Each screen is slightly different, but they have a number of common features:

- They list all of the currently-defined items in table format.

- You can assign names to each item. This makes your schedule easier to read. In addition, the names will be shown on your TV screen if you use the video screen system (however, only the first 16 characters of the name can be displayed on your TV).

- For many items, you can specify the initial states they should be put in when the schedule is first loaded. You can use this to ensure the schedule starts in a known state.

- You can enable or disable some items.

Working With Object Summary Tables

All of the object summary screens display the items in a table format. Here are some tips for working with these tables:

- If the table contains more than 16 items, a vertical scroll bar (or "elevator") will appear. You can then scroll through the multiple pages with a mouse. You can also use the cursor keys to move between items.

- Some tables have more columns than can be displayed at one time. These tables have a horizontal scroll bar to move between columns. The cursor keys also can be used for this purpose.

- You can directly edit some of the fields, such as the "Name" and "Description" fields. These fields support the standard Windows cut, copy, and paste functions.

- Some fields use checkboxes to select between two states. Use the mouse or cursor keys to first select the field. Then click with the mouse (left button) to toggle the checkbox on and off.

- The "Initial State" fields used on some screens have pop-up list boxes. When you select these fields, a downward-pointing arrow will appear at the right side. Click on this arrow to pop up the list. Use the mouse or cursor keys to select an option from this list. When you leave the field, the arrow will disappear.

- In the infrared signal summary screen, double-clicking on the "Signal Type", "Device Code", or "Key Code" fields opens another screen. This screen provides one way to define the format of the infrared signal to receive or transmit. When you close this screen, you'll be returned to the infrared signal screen.

Object Initial States

The object summary screens are also used to set the initial state of many object types. When you load a schedule to the controller for the first time, you need to specify the initial states you want the controller to set for the various objects. For example, you can define the following:

- What states to set for your output ports.

- What states (ON or OFF) and what levels (0 to 16) to assign to the X-10 modules. The controller will not know what state your lights or other X-10 modules are initially in. This provides one way to tell it.

The initial states are specified by setting the Initial State field in the object summary screens. Each object can be individually set to its own state. When the schedule is loaded into the controller, the objects will then be set to the specified initial state. Note that the objects' states don't immediately change when you set the value in the object summary screen, but only when the schedule is loaded to the controller.

What if you are making minor changes to a schedule that you already have running? Objects may already be set properly. You may not want them to change when you load the revised schedule. You can avoid changing the state of an object by selecting the "No Change" entry in the Initial Value Field. When the new schedule is loaded, the current state or value will be left unchanged.

Configuration Screens

These screens are accessed from the "Configure" menu and configure both the PC program and the controller:

- Serial Port
- Input/Output Port
- Controller Settings
- Video Remote Control
- Preferences

Serial Port Configuration Screen

This screen is used to set up the PC's serial port that is used to communicate with the controller. You can select the communications port (comm port, for short) as well as the baud rate. Several important points should be noted regarding the serial interface:

- The controller is initially set to a 19,200 baud rate.

- If the wrong comm port or baud rate is selected, the PC software will not be able to communicate with the controller.

- Changes to this screen only affect the computer settings, not the controller. To change the controller baud rate, use the controller command screen under the "Control" menu.

- These settings are stored in the preferences file on your hard disk.

- When the PC program starts, it will try to open the chosen serial port. If it is successful, the comm port number and baud rate will be shown in the main program window. If the port is in use by another program, an error will occur and will be reported to you. You must then close the port (usually by quitting the application that opened it) before the software can use it.

Input/Output Port Configuration Screen

The controller has three sets of ports, each with 8 lines (signals):

- Port A (output only)
- Port B (input only)
- Port C (input or output)

This configuration screen is used to configure port C as an input or output. You should set this properly before connecting any devices to this port.

WARNING: Do not set port C to an output if you have any devices connected that might be damaged by being driven to ground or 5 volts. The default condition for port C is as an input, which is the safest condition. See the chapter on input/output ports for details on using these ports.

Controller Settings Configuration Screen

The controller has a variety of settings you can control. This screen defines the configuration that will be set when the schedule is loaded. The controller is not immediately set to these values, but only when the schedule is loaded.

The options which are set from this configuration screen are listed below. Descriptions of what each of these does are provided elsewhere or in the help file. To access context-sensitive help, press the F1 key from any screen.

Event Logging Modes (enable or disable them)

X-10 Signal Log Mode
Input Port Log Mode

X-10 Settings

1-Phase or 3-Phase Transmission

# of Retries

<u>Infrared Signal Settings</u>

Gap Between Transmissions

<u>Other Settings</u>

Prevent User from Shutting Video System Off

Video Remote Control Configuration Screen

The controller uses a set of 16 remote buttons (keys) to navigate through the built-in video screen system. You use this screen to tell the controller which buttons on your remote you wish to use.

The screen displays three sets of 16 remote key codes, each accessed through a set of "tabs". You'll probably never need to use more than one of these three sets; the others allow different remotes to control the video screen system. The screen shows Key Codes and Description fields for each of the 16 buttons. It also shows the Device Code (all keys should have the same Device Code, but each will have its own Key Code). In order for a button on your remote to control the video screens, its Device Code and Key Code must be entered in the appropriate fields.

This screen also has a window which displays information on received infrared signals. You can use this to test whether your remote is set up to transmit the proper IR signal.

Detailed procedures for setting up the controller's infrared transmit and receive capability are provided in the infrared chapter.

Preferences Screen

This screen configures how the PC software works.

Control Screens

These screens, accessed from the "Control" menu, provide access to many of the controller's functions. Through them, you can directly control most of your home automation system. To use these, the controller must be connected to the computer's serial port. The screens are:

- X-10 Control (and X-10 grid control)
- Input/Output Port Control
- IR Control
- Video Control
- Controller Commands

X-10 Control Screen

From this screen you can:

- Transmit any standard X-10 signal
- Perform any of the custom X-10 commands

- View received X-10 signals
- Access the X-10 grid control screen

Refer to the X-10 chapter for the meanings of the various commands.

X-10 Grid Control Screen

This screen shows the status of all 256 addresses and allows direct control of each address. Note the following:

- When you open the screen, the software reads the status of all 256 X-10 addresses from the controller. This could take several seconds if the serial port is set to a slow baud rate or the computer is unusually slow.

- If the "Show Light Level" box is checked, the level of each address is shown in gray scale from black (full off) to white (full on). A module in the "neutral" state is shown in light blue.

- Click the left mouse button on any address in the grid. The "Selected Module" field will show the name and current state of the address.

- Click the right mouse button on any address in the grid. A pop-up menu will appear allowing you to send a standard X-10 command to that address.

- The "Update" button reads the latest module states from the controller and displays it.

- This screen automatically updates the module states when:

    1) You transmit an X-10 signal from this screen.

    2) The controller receives an X-10 signal.

Input/Output Port Control Screen

From this screen you can:

- View the state of all input and output ports
- Set any output port high or low
- Pulse any output port high or low for a precise length of time

You should note several points about this screen:

- When you first display the screen, the software will attempt to read the current port states from the controller. If unsuccessful, an error message will be displayed and you will not be able to control or read the ports.

- The port status is not updated automatically. Click the "Read" button to update them.

- Port C will be set as an input or output based on the settings currently loaded in the controller. To change this, you must load a new schedule with different settings.

IR Control Screen

From this screen you can transmit any infrared signal which has been previously loaded into the controller. You should note several points about this screen:

- When you first display the screen, the software will attempt to read the number of IR signals currently loaded in the controller. If unsuccessful, an error message will be displayed and you will not be able to transmit the signal.

- You can assign different signals and text descriptions to each of the 30 buttons. To do this, click on the text descriptions. A new window will open where you can select from the available signals and change their descriptions.

- When you click the button to transmit the signal, the PC will command the controller to transmit the signal with the corresponding ID number.

- The signal ID numbers and text descriptions for the buttons are stored in the computer schedule file. They are not loaded into the controller.

  NOTE: The schedule file you have opened on your computer should match the schedule loaded into the controller (or at least the IR signals should be the same). If not, there's a chance of transmitting the wrong signal.

  For example, assume you learned the IR signal to control your VCR's power and saved it to IR signal #20. You also set up this IR control screen to transmit signal #20 and called it "VCR Power". You then loaded this into the controller.

  Now assume you later learned a different IR signal to control your TV's power and also saved it to signal #20 (replacing the VCR power signal). You also changed the IR control screen description of signal #20 and called it "TV Power". However, you haven't yet loaded the revised schedule into the controller. If you click the button to transmit "TV Power", you will instead transmit the old VCR power signal instead. The new schedule must be loaded before any of the changes will take effect.

Video Control Screen

From this screen you can:

- Start or stop the video screen system
- Change the color, location, or blinking characteristics of the screen
- Display any of the built-in screens
- Display your own screen
- Switch between incoming video (if you've connected a video source) and the text display screens
- Display the text on a solid background or overlayed onto incoming video
- ... and more

You should note several points about this screen:

- If you attempt to display incoming video or overlay text on top of it and you haven't connected a video input to the controller, the display will be distorted or solid black.

- If the display text is erratic or is not clear, adjustment of the video signal level may be necessary. Refer to the video chapter for this.

This control screen provides the best way for you to learn how the various video commands work. You can also use it to see what the built-in video screens look like.

Controller Command Screen

From this screen you can send direct commands to do many things:

- Check communications with the controller
- Halt or resume controller operation
- Control the state of the user LED
- Change the controller's baud rate
- ... and more

Refer to chapter 8 for details on the various controller functions.

Other Screens

These screens are located under the "Other" menu and provide a variety of functions:

- Terminal Emulator
- IR Signal Learning
- IR Signal Testing
- Status Screen
- Read Event Log

Terminal Emulator Screen

This screen acts as a simple terminal emulator to communicate directly with the controller. It has two main uses:

1) You can view serial transmissions from the controller. This can be useful in debugging things. Also, when you apply power to the controller, you can make sure that it's working by looking for the serial transmissions from it. If you see nothing, something is not set up properly. If you see only unrecognizable characters, the PC's baud rate setting is probably incorrect.

2) You can send commands directly to the controller. You probably won't need to use this capability, as the other control screens can handle almost every command you'll want. However, if you're writing your own program to control the controller, you can use this screen to test out the command format and make sure you know exactly how it works.

Several points should be noted about this terminal emulator:

- To send commands to the controller, enter ASCII text in the top text box, then press the carriage return. The entire string of text, including the carriage return, will be sent at one time when you press the carriage return. You can use the backspace key or edit the text to get it right before you send it. Refer to the serial interface chapter for more details.

- The large window displays the data received from the controller. It does not show the data you send to the controller.

- The normal command response from the controller includes some unprintable characters. These are shown in the window as a square box.

You can also use any standard terminal emulator or communications program to communicate with the controller if you wish.

IR Learn Screen

Use this screen to teach infrared signals to the controller so that it can transmit them and control your audio/video equipment.

IR Test Screen

With this screen, you can:

- Transmit any infrared signal which is currently loaded in the controller.

- Transmit any "standard" format IR signal. You can transmit a signal with any Device Code and Key Code. You can use this to "train" a "learning" remote, which can then be used to control HomeVision-PC.

- Determine the Device Code and Key Code of any standard format IR signal which you transmit to the controller. The screen displays this information for infrared signals which the controller receives.

Refer to the infrared control chapter for a description of the various IR signal formats and how to use them.

Status Screen

This screen provides information on the current schedule and the controller's current operating modes.

One tab displays information about the current state of the controller. To read the current state, click the "Read" button. The display is only updated when you click this button; it does not update automatically. It shows information about how the controller is operating. The following data is provided:

- **File Name, Date, and Time**. This shows which schedule file was last loaded into the controller. The time and date are of the file itself, not the time the schedule was loaded into the controller.

- **Controller Running (or Halted)**. This indicates whether the controller is currently running or is halted. It will be halted when loading a schedule, after it executes a "Halt Controller" command, or if an error occurs.

- **Self-Test Passed (or Failed)**. This indicates whether the controller's most recent self-test (performed every time power is applied) passed or failed. If it fails, the controller will be automatically halted to prevent possible erratic operation. It will also tell you which test(s) failed.

- **TW-523 OK (or Error)**. This indicates whether a TW-523 module (used to receive and transmit X-10 signals) is connected and functioning properly. This should match the TW-523 LED on the controller's front panel.

- **RAM OK (or Error)**. This indicates whether the controller's RAM is properly loaded. This error could occur if a schedule download is aborted before it completes. If you see this error, you must reload your schedule.

- **No Controller Error (or Error ##)**. During normal operation, the controller constantly checks for error conditions. If one occurs, it records the error number. Errors can occur for a variety of reasons and do not necessarily mean there is a real problem. Refer to the "Miscellaneous" chapter for details on error messages.

- **PROM Version**. This shows the version of PROM in the controller.

The other tab displays information about the schedule currently open on the PC. It displays the amount of controller memory used by your infrared signals. This data is only available after loading a schedule into the controller. Until it's loaded, the software cannot determine how many bytes of RAM it will take. This memory stores your "learned" infrared signals. Signals are stored by recording the lengths of the individual pulses. Typical signals require from 60 to 200 bytes. Approximately 45,000 bytes are available (the exact amount is shown on the screen). This should be more than enough to hold 255 typical signals.

Read Event Log Screen

The controller can record events in an internal 256-line log which can be displayed on the TV. Use this screen to read the log and display it on the PC.

CHAPTER 3: QUICK START

This section describes the necessary steps for getting the controller initially up and running.   It explains how the controller should act at each point so you can verify it's working properly.

1) Make sure you have everything you need

The following items are supplied with the controller:

- HomeVision-PC Control unit
- TW-523 (or equivalent) X-10 interface module
- Phone cord
- Power transformer (9VDC, 2.1mm plug, center tap positive, 300mA or higher current rating)
- Serial cable (DB-9 male to DB-9 female)
- 3.5 inch installation disks
- This owner's manual
- User registration card

To run the PC software, you need a computer with the following capabilities:

- IBM-compatible computer (80486 or higher). A 486DX2/66 is recommended as the minimum configuration to provide adequate operating speed
- Minimum of 4 Mbytes or RAM (8 Mbytes preferred)
- VGA or better monitor
- Windows 3.1 or higher or Windows 95 operating system
- One 3.5 inch floppy drive
- Hard disk with at least 6 Mbytes free
- A mouse
- One free serial port (minimum of 19,200-baud)

You may also want to have these handy:

- An X-10 transmitter (such as a mini-controller) so you can verify the controller can receive X-10 signals.
- An X-10 receiving device (such as a wall switch or lamp module) so you can verify the controller can transmit X-10 signals.
- If you want to view the video screen system, you'll need:
    - A TV with a video input jack
    - A video cable with RCA plugs to connect the TV to the controller.
- If you want to provide video input to the controller, you'll need:
    - A video source (such as VCR, camcorder, video game, etc.) with a video output. This requires an Audio/Video type output jack, not an RF coaxial cable output.
    - A second video cable with RCA plugs.
- A programmable or learning infrared remote control.
- A Phillips screwdriver in case you need to adjust the video signal level from within the controller.

2) Make controller connections

- Plug the power transformer into a 110VAC (standard for the U.S.) wall outlet and the connector end into the controller's "Power" jack. Several controller LEDs will flash briefly,

then only the "On" LED should be lit. If it doesn't light, refer to the "Trouble-shooting" chapter.

- Plug the TW-523 module into a 110VAC wall outlet. Use the phone cable to connect the TW-523 to the "TW-523" jack on the controller. The controller LED labeled "TW-523" should light.

- Use the serial cable (with 9-pin connectors) to connect the controller to a serial port on your PC. If your computer only has a 25-pin serial connector, an adapter will be needed.

- If you wish to view video screens, you must connect the video output jack to a video input on your TV or VCR. Any standard phono cable with RCA-type jacks can be used. The audio jacks on your equipment are not used.

- Connections for video input, infrared output, and input/output ports are not covered in this "Quick Start" section. Refer to their specific chapters when you're ready to hook them up.

3) Install PC software

Before installing the software, make backup copies of the software disks. To install the software:

A) Start Microsoft Windows.

B) Insert Installation Disk #1 into drive A (or B).

C) From the File menu of the Program Manager or File Manager, choose Run.

D) Type a:setup (or b:setup), then press "OK". Follow the instructions on the screen.

4) Run PC software

To run the software:

A) From the Program Manager, open the HomeVision program group.

B) Double-click the HomeVision-PC application.

5) Set preferences

Select "Preferences" from the "Configure" menu. Make sure "Demo Mode" is not checked (in Demo Mode, the software will not attempt to send commands to the controller, as it assumes it is not connected).

6) Configure serial interface

Select "Serial Interface" from the "Configure" menu. Select the communications port the controller is connected to. Set the baud rate to 19,200 (the controller's default setting).

7) Verify serial interface and controller are operating

Select "Terminal Emulator" from the "Other" menu. Remove power from the controller, then reapply it. The controller should transmit a message to the PC, which displays the message in the terminal emulator window. If unreadable characters appear, the baud rate is probably incorrect. Verify that the PC is set to 19,200 baud in the "Serial Interface" screen (under the "Configure" menu). If it is, it's possible the controller has been set to a different speed. Try changing the PC to the other speeds. If this doesn't work, refer to the trouble-shooting chapter.

8) Verify controller can receive serial commands

Select "Controller Command" from the "Control" menu. In the command list box, select the command "Turn User LED On". Send this command to the controller by clicking the "Send Command" button. You can also send it by double-clicking the command itself. The controller LED labeled "U" (short for User) should light up. Send the command "Turn User LED Off" and verify the LED goes off. This LED can be used for any purpose you choose in your schedule.

9) Verify X-10 operation

Select "X-10 Control Screen" from the "Control" menu. To verify the controller can receive X-10 signals:

- Use an X-10 transmitter (such as mini-controller) to transmit a signal through your house.

- The X-10 RX LED on the controller's front panel should blink as it receives the signal.

- If properly configured, the controller will report the signal to the PC. The simulated LED on the control screen should blink and a message should be displayed in the message window. This message will show the received X-10 signal.

To verify the controller can transmit X-10 signals:

- Select a house code and unit code from the left side of the control screen.

- Select a command (such as ON or OFF) from the "Standard X-10 Commands" list.

- Click the "Send Complete Command" button to transmit it.

- The X-10 TX LED on the controller's front panel should blink as it transmits. The X-10 RX LED should also blink, as the controller will receive its own transmission.

- Any X-10 device(s) set to the selected house and unit code should respond.

You can also test the other X-10 commands available from this screen if you wish. All commands are fully functional even if you haven't loaded a schedule into the controller.

10) Verify video output

This step is only applicable if you have the video output connected; if not, continue to step 11.

- The controller initially contains a sample schedule loaded at the factory. This schedule automatically displays the main menu of the video screen system upon power-up.

- Set your TV to view the controller's video output. The main menu should appear as white text on a blue background. If the text is blurry or the screen appears scrambled (like a scrambled TV channel), the video sync level requires adjustment.   The video chapter explains how to make this adjustment. If there appears to be no video output, remove and then restore power to the controller. If there is still no video, refer to the trouble-shooting chapter.

- Select "Video Control Screen" from the "Control" menu.

To try creating your own custom screen:

- Select screen number 0. The screen should go blank.

- To display a string of text, enter the text and click the "Write Text" button.

- To type text directly on the screen, select the "Typewriter" mode by clicking in the Typewriter text field. Press a key and the character will be displayed on the screen. Letters and numbers will appear just as you type them. Many of the other display characters do not match the keyboard keys. Experiment with the different keys to learn what display characters are available.

- If you've connected an external video signal to the controller's video input jack, you can switch between this signal and the On-Screen Display (OSD). Set the video switch to the external video position in the "Settings" window and click the "Load Settings Into Controller" button. The externally-supplied video signal will be routed to the video output. To return to the On-Screen Display, return the switch to the internal video position.

- You can experiment with the other commands on this screen at your leisure.

11) Verify infrared remote receive capability

To verify the controller can receive IR signals:

- Select "Video Remote Control" from the "Configure" menu.

- Aim a standard remote control device at the controller's front panel and press any key. The controller's "IR RX" LED should light as the signal is received. If it doesn't, refer to the trouble-shooting chapter.

- If properly configured, the controller will report the signal to the PC. The simulated LED on the control screen should blink immediately after the signal is received. If the signal happens to match the "standard" signal format used by the controller, the signal's Device Code and Key Code will be displayed in the window. If the signal is a different format, question marks will be shown in these fields.

12) Setting Up Your Remote To Control The Video Screens

The controller uses a set of 16 remote buttons (keys) to navigate through the built-in video screen system. You have many options for setting this up, as detailed in the Infrared Control chapter. However, this section provides a brief description of how to set a programmable remote to the controller's default setting.

1) Open the video IR control configuration screen under the "Configure" menu. This screen displays three sets of 16 remote key codes, each accessed through a set of "tabs" (you'll probably never need to use more than one of these three sets; the others allow different remotes to control the video screen system).

   The screen shows Key Codes and Description fields for each of the 16 buttons. It also shows the Device Code (all keys should have the same Device Code, but each will have its own Key Code). In order for a button on your remote to control the video screens, its Device Code and Key Code must be entered in the appropriate fields, then loaded into the controller. Initially, these are set to the controller's default remote keys.

2) The default device is a Hitachi TV remote, but you can set any programmable remote to transmit the same signals. Look up the brand name of your programmable remote in the list below. The number beside it is the code for the Hitachi TV. Set your remote to this code using the procedure in your remote's owner's manual.

One For All	Code 145
Control One	Code 145
Emerson	Code 145
Gemini	Code 100
RCA	Code 047
Sony	Code 31
Magnavox	Code 0030

   If you have a different brand of remote, look up the code number for a Hitachi TV in your remote's owners manual. The manual will probably list several codes. Try each one until you find one that works (testing it as described below).

3) To test the 16 video screen control buttons, push each of the corresponding buttons on your remote (one at a time!). The window's simulated "LED" will blink and the Device Code and Key Code for the received signal will be shown. Compare these to the codes listed beside each of the 16 functions. If all 16 buttons match, you're ready to control the video screens. If some of the buttons use different Key Codes, you can change the entry to match the actual received Key Code. Some points to note:

   • All signals from a specific remote should have the same Device Code. This code should match the one shown in the Device Code text box.

   • To assign a different remote key to a function, enter the signal's actual Key Code in the text box next to the function. If you make any changes, you will have to reload the schedule into the controller.

   • If your remote is transmitting different Device and Key Codes than those shown, it's not a problem. Just enter the actual Key Codes in the text boxes corresponding to each function, and the Device code in the Device Code text box. However, if you make such changes, you will have to reload the schedule.

   • Most remotes don't have a "Cancel" button; we've assigned this function to the "Mute" button. You may want to move this to a different button that works better with your remote's keypad layout.

   • If you make any changes to this screen, you'll need to reload the schedule into the controller. To do this, choose "Load Schedule" from the "File" menu. Click the "Load" button to load the schedule. You should also save the schedule (using the "Save" button under the "File" menu).

- The settings from this configuration screen are saved along with your schedule. If you create a new schedule, you'll have to set these again.

4) If all 16 buttons are working, you can now use the remote to navigate through the video screen system (assuming you have the video output connected to your TV). You can then:

- Display the video screen system on your TV (using the video control screen).
- Start the video screen system with the Channel Up key.
- Stop the video screen system with the Channel Down key (unless video system is configured to be on all the time).
- Use the Volume Up and Down keys to scroll through screen "pages".
- Use the number keys to select from the lists.
- Use the Enter and Cancel keys to confirm or cancel an action.

CHAPTER 4: X-10

Introduction

X-10 signals are transmitted over the 110VAC power lines within the house. These signals are used to control equipment located throughout the house. The controller provides the following X-10 features and capabilities:

- Can receive and transmit all X-10 commands.

- Maintains a state table showing the On/Off state and level of all 256 X-10 addresses (modules).

- Module states can be viewed and changed from the video screen system.

- Modules states can be read and changed from the serial interface.

Throughout this manual, we refer to X-10 "modules". There are many types of modules:

- Wall switches to control lights
- Plug-in appliance modules (both 110VAC and 220VAC) into which you can plug other devices
- Relay interface modules which can open or close relay contacts when a specific X-10 code is received
- Powerflash modules which can sense opened or closed contacts and transmit an X-10 code in response
- Chime modules
- Thermostats which respond to X-10 commands
- And others ...

As you can see, there are a wide variety of X-10 compatible items available. We use the term "modules" to refer to any device which can receive or transmit X-10 signals.

Controller X-10 Operation

The controller constantly monitors the AC power line in your home, checking for X-10 signals. It uses the TW-523 Two-Way Power Line Interface device manufactured by X-10 (USA) Inc. for this purpose. The X-10 code format is patented, and the TW-523 or similar device must be used for this interface. A TW-523 is provided with the controller. Any X-10 signal which is detected on the AC power line by the TW-523 is passed on to the controller.

The controller maintains an internal table which keeps track of the current state of all X-10 devices. Whenever an X-10 signal is detected by the TW-523, the controller updates the state table to reflect the new state. The controller also updates the table whenever it transmits an X-10 signal. The controller always keeps track of all 256 house/unit codes regardless of which ones you use. Two separate parameters are tracked:

- **ON/OFF Status**. All devices are either ON or OFF. Devices that are ON will also have a level of 0 to 16. Devices that are OFF will have their level set to 0.

- **Level**. Many lights and lamp modules can be dimmed to levels between full on and full off. The controller keeps track of the current level by assigning it a number from 0 to 16. Level 16 is full on. Lower values represent decreasing brightness levels. Modules that cannot be dimmed will always have a level of 16 when on.

Many lights/modules can be dimmed all the way down to zero. This is not the same as turning it off. A light which is on at level 0 will respond to brighten commands by brightening one step at a time. Most lights that are off will go to full brightness when they receive a brighten command. There are some X-10 compatible lighting control modules available that can be directly set to any desired level without first going to full brightness.

X-10 Codes

X-10 modules are uniquely identified by House Codes and Unit Codes. Function codes specify the action which should be performed by the selected module. These codes are briefly described below:

- **House Codes**: There are 16 house codes represented by the letters A through P.

- **Unit Codes**: There are 16 unit codes numbered 1 through 16. Each X-10 compatible device is addressed with one house code and one unit code. Since each of the 16 house codes has 16 unit codes, a total of 256 (16 x 16) unique devices can be addressed in the X-10 protocol.

- **Function Codes**: These codes specify the action that will occur for the addressed device(s). Some function codes act on individual modules (selected by house code and unit code), while others act on all devices with the same house code.

  There are 13 function codes available, as listed below. The first seven are by far the most widely used; most devices don't support the other eight. However, the controller can transmit and receive all of these codes.

    - On
    - Off
    - Brighten
    - Dim
    - All Lights On (operates on entire house code)
    - All Units Off (operates on entire house code)
    - All Lights Off (operates on entire house code)
    - Pre-Set Dim
    - Hail Request (operates on entire house code)
    - Hail Acknowledge
    - Status Request
    - Status Is On
    - Status Is Off

X-10 Signal Transmissions

The controller provides well over 40 different commands for transmitting X-10 signals. This gives you a wide variety of options for controlling X-10 devices. To make the best use of these, it's important to understand how X-10 signals are transmitted.

There are two different types of X-10 signal transmissions:

- **House/Unit Codes**. This transmission consists of a single house code and unit code. It is used to select which X-10 device the command is intended for. Any module that receives a house/unit code that matches its own will "arm" itself in preparation for a subsequent house/function code command. It is usually possible to send multiple house/unit codes in succession, arming multiple devices. All the armed devices will then respond at the same time to a subsequent house/function code command. This signal takes approximately four-tenths of a second to transmit over the power line.

- **House/Function Codes**. This transmission consists of one house code and one function code. Some of the function codes will perform their function on the entire house code. However, most only act on individual devices which have been armed by prior house/unit code commands. This signal takes approximately four-tenths of a second to transmit over the power line.

Examples

A few examples of X-10 signals transmitted from the controller or other devices will help clarify this:

- **Example**: You press the button Unit 5 On on a mini-controller which is set to house code A (with HomeVision-PC, the command "X-10 A-5 On" in your schedule would do the same thing).

    X-10 Transmissions:

    First, the house/unit code combination of house code A and unit code 5 is transmitted. This arms any device set to A-5. Second, a house/function code combination of house code A and the function code On is transmitted. Module A-5 will then turn on since it was previously armed and the house/function code command was addressed to its house code (A).

- **Example**: After turning device A-5 on in the previous example, you press the Dim button on the same mini-controller.

    X-10 Transmissions:

    A house/function code combination of house code A and function code Dim is transmitted. Module A-5 will remain "armed" after being turned on and will therefore respond to the Dim command by dimming one level. If you continue to press the Dim button, the same house/function code command will be sent repeatedly, dimming the module (presumably a light).

- **Example**: From the X-10 control screen in the PC software or from commands in your schedule, you send the following signals:

    - House/Unit Code: A-5
    - House/Unit Code: A-7
    - House/Unit Code: A-8
    - House/Function Code: A-On
    - House/Function Code: A-Dim

    Effect:

First, the three house/unit code combinations arm modules A-5, A-7, and A-8. The house/function code combination A-On causes all three modules to turn on simultaneously.   The subsequent A-Dim command causes all three modules to simultaneously dim once.

- **Example**: From the X-10 control screen in the PC program or from commands in your schedule, you send the following signals:

  - House/Unit Code: A-5
  - House/Function Code: A-On
  - House/Unit Code: A-7
  - House/Function Code: A-On
  - House/Unit Code: A-8
  - House/Function Code: A-On
  - House/Function Code: A-Dim

  Effect:

  Unlike the previous example, these modules will not respond simultaneously. First, module A-5 will be turned on. Approximately 1 second later, A-7 will go on. In another second, A-8 will come on. The final Dim command will cause only A-8 to dim once.

- **Example**: You press the button All Lights Off on a mini-controller which is set to house code A.

  X-10 Transmissions:

  A house/function code combination of house code A and function code All Lights Off is transmitted. All modules which have a house code of A will immediately turn OFF. Note that no house/unit code transmission is required. This command affects all devices with the specified house code, regardless of their unit code.

X-10 Transmission Settings

X-10 commands can be transmitted over either 1 or 3 phases of the AC power line. Most residential applications only need to transmit on one phase. However, in some instances, you may need 3-phase transmission. You can set the mode from the controller configuration screen under the "Configure" menu. You can also include commands in your schedule to change the method at any time. These commands are located under the controller command button on the actions entry screen.

The number of retries when an X-10 transmission fails is variable from 0 to 31. You can set this from the controller configuration screen under the "Configure" menu.

X-10 Lighting Scenes

Some of the newer X-10 devices, like the LM14A lamp module and the Leviton 6381 wall switches, support "scenes". A scene is a group of X-10 modules that can all be set to a predetermined level with a single command. Scenes require the use of X-10 "extended codes", which HomeVision can

transmit. HomeVision supports scenes by allowing you to add modules to a scene, remove them from a scene, and execute the scene. You can have up to four scenes per house code.

There are two steps to using scenes:

1) Create the scene(s)
2) Execute a scene

You create scenes by using the X-10 control screen in the PC software. You can execute a scene from this same screen or with another program that supports this capability.

Creating Scenes

To create scenes, open the X-10 control screen in the PC software. The HomeVision-PC controller must be connected to the PC. You will use the following two "custom commands" located near the bottom of the custom command list box:

1) Include in scene # at level XX (of 63)
2) Remove from scene #

Note that the light levels range from 0 to 63. This is consistent with the "Set directly to level ##" command that these modules respond to.

As an example, assume you want to create these two scenes using modules A-1, A-2, and A-3:

Scene 1:	A-1 on at level 10
	A-2 on at level 15
	A-3 on at level 20
Scene 2:	A-1 off (level 0)
	A-2 on at level 50
	A-3 on at level 63

Here's how you'd create these scenes:

1) Select house code "A" and unit code "1".
2) Select the custom command "Include in scene # at level XX".
3) Enter "1" in the scene number text box.
4) Enter "10" in the light level text box.
5) Click the "Perform Command" button. This will send an X-10 command to module A-1 telling it to include itself in scene 1 at level 10.
6) Select unit code "2" and level "15" and click the "Perform Command" button to put A-2 in the scene.
7) Select unit code "3" and level "20" and click the "Perform Command" button to put A-3 in the scene. Scene 1 is now complete.
8) Change the scene number to "2". Repeat the above steps using the desired levels for scene 2.

The above steps send the necessary commands to the X-10 modules to put them in the two house code "A" scenes. The modules will retain this information through power failures, so you only need to do this setup once.

If you decide you don't want a particular module to be in a scene, use the "Remove from scene #" command to remove it. To test whether the scene works, transmit the "Execute scene #" command, as described in the next section.

Executing Scenes

"Executing" a scene means sending an X-10 signal to command the modules to go to the desired scene. All modules in the scene should simultaneously go to their preset level. You can execute a scene either from the X-10 control screen in the PC software or within a schedule. To execute a scene from the PC, open the X-10 control screen. Then:

1) Select the desired house code (the unit code doesn't matter, as scenes apply to the entire house code).
2) Select the custom command "Execute scene #".
3) Enter the scene number in the scene number text box.
4) Click the "Perform Command" button. This will send an X-10 command to the house code and all the lights in the scene should respond.

X-10 Commands

Overview

This section provides an overview of the various types of commands. Following this are detailed descriptions of each command.

Standard X-10 Commands Which Transmit X-10 Signals

This group of commands causes the controller to transmit X-10 signals over the power line. The basic X-10 commands include On, Off, Brighten, and Dim. However, the controller also supports a wide variety of additional commands.

These X-10 commands can be broken into three major groups:

1) The first group of commands transmit X-10 signals unless/until the X-10 module reaches a certain state. These commands are:

    - `On`
    - `Off`
    - `Dim`
    - `Dim ## Times`
    - `Brighten`
    - `Brighten ## Times`
    - `Set To Level ##`

    Before transmitting these commands, the controller checks the current state of the module. If the module is in a state where the command would have no effect, the command will not be sent. For example, if a module is OFF when an OFF command is executed, No Off command will be sent over the power line. Similarly, an ON command will not be sent to a module already ON, and a Brighten command will not be sent to a module already ON at Level-16 (the maximum level).

    This procedure minimizes transmissions over the power line. Sending a command to a module that is already in the desired state will have no effect. However, the transmission could interfere with other devices in your house which might be transmitting at the same time.

To reduce this possibility, it's best to minimize the number of transmissions you send over the power lines.

One problem with these commands can occur if the controller cannot properly track the module states. For example, standard X-10 wall switches allow manual control of their lights. However, when you manually change them, no X-10 signal is sent out from the switch. Therefore, the controller will not know that the light has changed. Its internal state table will be incorrect, causing these commands to work improperly. For example, assume that a light is off and the controller has correctly kept track of it. You then manually turn the light on at the wall switch (which the controller is unaware of). Assume now that your PC software executes an Off command for this light. The controller thinks the light is already off and therefore does not send the OFF command. The light stays on.

Because of this potential problem, these commands are best used for X-10 modules that aren't normally controlled manually. As long as the controller can keep track of the state, these commands will work properly and minimize the number of X-10 transmissions. For modules that are controlled manually, the next group of commands is more appropriate.

2) The second group contain the same basic commands as the first group, but are Force commands. These commands are:

- `Force On`
- `Force Off`
- `Force Dim`
- `Force Dim ## Times`
- `Force Brighten`
- `Force Brighten ## Times`
- `Force To Level ##`

These commands will always transmit the specified X-10 signals regardless of the current state of the module. They guarantee that your specified commands are sent over the power line.

3) The third group of standard commands contains some of the same commands as previous groups, but with the keyword "Slow" afterwards. These commands are:

- `Dim ## Times Slow`
- `Force Dim ## Times Slow`
- `Brighten ## Times Slow`
- `Force Brighten ## Times Slow`
- `Set To Level ## Slow`
- `Force To Level ## Slow`

These commands transmit multiple Brighten or Dim commands, usually to change the level of lights. The standard commands without the keyword "Slow" will transmit the signals about one-half second apart. These "Slow" commands will spread them out approximately one second apart. This can make the lighting change a little more gradual, which may be desirable in some applications.

Advanced X-10 Commands Which Transmit X-10 Signals

These advanced commands provide more control methods than the basic On, Off, Brighten, and Dim commands discussed previously. These commands are:

- `Toggle Module`

- Transmit House/Unit Code Only
- Transmit House/Function Code Only
- Transmit "Preset Dim" to Level ##
- Refresh Module
- Refresh House Code
- Set X-10 Device Directly To Level ##
- Execute Scene #

X-10 Control Commands

These commands do not actually transmit any X-10 signals. Instead, they are used to set or change how the controller operates with respect to these X-10 modules. These commands are:

- Enable Module
- Disable Module
- Set State To On
- Set State To Off
- Set State To Neutral
- Read Current State

Advanced X-10 Commands

Six X-10 signals are called "advanced" in this manual. These signals are not implemented by most X-10 compatible devices. However, if they are implemented, they can provide additional control capabilities. The controller can transmit and receive all of these commands. They are:

- Status Request
- Status Is On
- Status Is Off
- Hail Request
- Hail Acknowledge
- Preset Dim

PCS Lighting Commands

Powerline Control Systems (PCS) lighting modules are available that can be directly set to any level and dimmed in 1/2% increments. They are controlled by the following X-10 commands:

- Set PCS Light Level To ##
- Micro-Dim PCS Light 1 Level (1/2%)
- Micro-Brighten PCS Light 1 Level (1/2%)

X-10 Command Details

On

> If the module is initially OFF or NEUTRAL, this command sends an X-10 On command and sets the internal state level to 16. If the module is already ON, no action is taken.

Force On

This command sends an X-10 On command regardless of the current module state. If the module is initially OFF or NEUTRAL, it sets the internal state level to 16. If the module is already ON, the level is unchanged.

`Off`

If the module is ON or NEUTRAL, this command sends an X-10 Off command and sets the internal state level to 0. If the module is already OFF, no action is taken.

`Force Off`

This command sends an X-10 Off command regardless of the current module state and sets the internal state level to 0.

`Dim`

This command sends an X-10 Dim command unless the module is already ON and at level 0. The first Dim command sent to a module that is OFF or NEUTRAL causes it to go ON at level 16.

`Force Dim`

This command sends an X-10 Dim command regardless of the current module state. The first Dim command sent to a module that is OFF or NEUTRAL causes it to go ON at level 16.

`Dim ## Times`

This command sends "##" (a specified number) X-10 Dim commands, but stops sending commands if the level reaches 0. A module that was initially OFF or NEUTRAL will go ON at level 16 with the first Dim command, then decrease one level on each subsequent Dim command.

"##" can be between 1 and 23. Although 16 steps should be enough to go to full dim, some devices aren't so well behaved. A few extra Dim commands may be needed to ensure they go to level 0.

`Dim ## Times Slow`

Same as Dim ## Times, except that commands are sent at intervals of approximately 0.9 seconds instead of 0.4 seconds. (Actually, what happens is that the house code and unit code is repeated between each Dim command, instead of just sending consecutive Dim commands).

`Force Dim ## Times`

Same as Dim ## Times, except that all Force Dim commands will be sent even after level reaches 0.

`Force Dim ## Times Slow`

Same as Force Dim ## Times, except that commands are sent at intervals of approximately 0.9 seconds instead of 0.4 seconds. (Actually, what happens is that the house code and unit code is repeated between each Force Dim command, instead of just sending consecutive Force Dim commands).

`Brighten`

This command sends an X-10 Brighten command unless the module is already ON and at level 16. The first Brighten command sent to a module that is OFF or NEUTRAL causes it to go ON at level 16.

Force Brighten

This command sends one X-10 Brighten command regardless of the current module state. The first Brighten command sent to a module that is OFF or NEUTRAL causes it to go ON at level 16.

Brighten ## Times

This command sends "##" X-10 Brighten commands, but stops sending commands if the level reaches 16. A module that was initially OFF or NEUTRAL will go on at level 16 with the first Brighten command, then no more commands will be sent since level is already 16.

"##" can be between 1 and 23. Although 16 steps should be enough to go to full bright from level 0, some devices aren't so well behaved. A few extra bright commands may be needed to ensure they go to full brightness.

Brighten ## Times Slow

Same as Brighten ## Times, except that commands are sent at intervals of approximately 0.9 seconds instead of 0.4 seconds. (Actually, what happens is that the house code and unit code is repeated between each Brighten command, instead of just sending consecutive Brighten commands).

Force Brighten ## Times

Same as Brighten ## Times, except that all Brighten commands will be sent even after the level reaches 16.

Force Brighten ## Times Slow

Same as Force Brighten ## Times, except that commands are sent at intervals of approximately 0.9 seconds instead of 0.4 seconds. (Actually, what happens is that the house code and unit code is repeated between each Brighten command, instead of just sending consecutive Brighten commands).

Set To Level ##

This command sends X-10 Dim or Brighten commands as necessary to put the module at "##" brightness level. If the module is initially OFF or NEUTRAL, it sends one X-10 On command first, then Dim commands until level "##" is reached.

"##" can be any integer between 0 and 16.

Set To Level ## Slow

Same as Set To Level ##, except that commands are sent at intervals of approximately 0.9 seconds instead of 0.4 seconds. (Actually, what happens is that the house code and unit code is repeated between each Dim/Brighten command, instead of just sending consecutive Dim/Brighten commands).

Force To Level ##

Same as Set To Level ##, except that an X-10 Off command is sent first to ensure starting at a known condition.

Force To Level ## Slow

Same as Force To Level ##, except that commands are sent at intervals of approximately 0.9 seconds instead of 0.4 seconds. (Actually, what happens is that the house code and unit code is repeated between each Dim/Brighten command, instead of just sending consecutive Dim/Brighten commands).

Transmit House/Unit Code Only

This command sends the house code and the unit code without a function code. It is usually used when you want to "arm" several modules in preparation for a subsequent function code. The function code will then be performed by all modules simultaneously.

Transmit House/Function Code Only

This command sends the house code and function code without a unit code. The 12 available function codes are:

- On
- Off
- Brighten
- Dim
- All Lights On
- All Units Off
- All Lights Off
- Hail Request
- Hail Acknowledge
- Status Request
- Status Is On
- Status Is Off

(Note: "Preset Dim" is sent with a separate command, below.)

Transmit Preset Dim To Level ##

This command sends the advanced X-10 command "Preset Dim" with the level specified in ##. It does not change the current state set in the state table. This command can be used for the X-10 lights which can receive the "Preset Dim" command.

Toggle Module

This command sends an X-10 On command if the module is OFF. If the module is initially ON or NEUTRAL, it sends an X-10 Off command.

Refresh Module

This command sends an X-10 On command if the current state is ON (regardless of level). It sends an X-10 Off command if the current state is OFF. This ensures the specified module is in the state the controller thinks it should be in. However, since it doesn't send Brighten or Dim commands, the level may not be correct.

Refresh House Code

This command works the same as the Refresh Module command, except that it refreshes all 16 units in the specified house code. Care should be taken in using this command, as it will take nearly 16 seconds to complete (approximately 1 second for each unit code).

`Disable Module`

This command disables the module. A disabled module will not respond to any commands except for Enable Module.

`Enable Module`

This command enables a module that was previously disabled. A module must be enabled before it will respond to any commands or transmit an X-10 signal.

`Set State To On`

This command sets the current state in the state table to ON, Level 16. It does not send any X-10 signal over the power line.

`Set State To Off`

This command sets the current state in the state table to OFF, Level 0. It does not send any X-10 signal over the power line.

`Set State To Neutral`

This command sets the current state in the state table to NEUTRAL. It leaves the level unchanged. It does not send any X-10 signal over the power line.

`Transmit Module Status Signal`

This command sends either the advanced X-10 command "Status is On" or "Status is Off", depending on the current state of the module. It does not change the current state set in the state table. You might use this in response to a "Status Request" signal sent from another device.

`Read Current State`

This command causes the controller to read the module's state (ON/OFF and level) and to transmit it over the serial interface. This allows an external computer or other device to determine the state of a module.

`Set PCS Light Level To ###`

This command sets a PCS lighting module directly to the specified level ###. ### can be any level from 0 to 31. 0 means full off and 31 means full on. This command is implemented by sending an X-10 Preset Dim command to the appropriate level.

Unlike most X-10 devices, dim and brighten commands are not needed with PCS modules. This enables lights to be quickly set to any level. The controller will not adjust the level in its internal state table for PCS modules when this command is used. Since these modules can be directly set to any level, there's generally no need for this feature.

`Micro-Dim PCS Light 1 Level (1/2%)`

PCS lighting modules support a "micro-dim" command which decreases the brightness in steps of approximately 1/2% . This command is implemented with the X-10 Hail Request command.

The controller will not adjust the level in its internal state table for PCS modules when this command is used. Since these modules can be directly set to any level, there's generally no need for this feature.

```
Micro-Brighten PCS Light 1 Level (1/2%)
```

PCS lighting modules support a "micro-brighten" command which increases the brightness in steps of approximately 1/2%. This command is implemented with the X-10 Hail Acknowledge command.

The controller will not adjust the level in its internal state table for PCS modules when this command is used. Since these modules can be directly set to any level, there's generally no need for this feature.

```
Set X-10 Device Directly To Level ##
```

This command sets the device directly to the specified level (0 to 63). It only works with devices that support the newer X-10 "extended codes".

The newer Leviton 6381 switches and X-10 LM14A and AM14A modules have several new features. One of these is that they can be directly set to a level without going on to full brightness first. This is sometimes called "preset dimming", although this is not technically correct. HomeVision-PC can control these lights using X-10's "extended codes". These "extended codes" follow a different format than the older extended codes (whose commands were shown earlier). You should also note that these are different than the "preset dim" commands used by the PCS brand lighting modules.

The devices can be set to any of 64 levels (0 to 63). Sending a level 63 command immediately turns the light on to full brightness. Any other level command causes the light to slowly change to the desired level over several seconds. If the module is off, it does not go to full brightness first. In our testing, it appears that levels 62 and 63 are the same (full on). However, the level 62 command causes the light to slowly brighten, while the level 63 command sets it immediately to full on. Level 0 is the same as sending a standard OFF command. These modules also respond to all the standard X-10 commands (ON, OFF, BRIGHTEN, DIM, etc.).

You should note that these modules may be incompatible with certain X-10 "repeaters". If you have trouble with them, contact the manufacturer.

```
Execute Scene #
```

This command tells all X-10 devices in the specified house code to go to the specified scene. It only works with devices that support the newer X-10 "extended codes". The scene number can be 1 to 4. Refer to the "X-10 Lighting Scenes" section for a detailed description.

CHAPTER 5: INPUT AND OUTPUT PORTS

Introduction

Input and output ports provide the following features and capabilities:

- Port A provides 8 "relay driver" or "open-collector" output lines capable of sinking 500mA of current at up to 50 volts. These can be used to drive relays, solenoids, LEDs, etc.

- Port B provides 8 digital input lines which can accept up to +/-30V and be read as a one or zero. The input lines contain pull-up resistors allowing them to be directly connected by switch closure inputs from alarm contacts, motion sensors, etc. They can also read TTL or CMOS digital inputs.

- Port C provides 8 digital lines configurable as inputs or outputs (all 8 lines must be configured the same). As inputs, the lines can read TTL or CMOS digital inputs or can be directly connected to switch closure inputs (they contain internal pull-ups). As outputs, they can drive TTL or CMOS loads or other low-current peripherals such as LEDs.

- Output lines can be individually set high, low, or toggled.

- Output lines can be individually pulsed for specified times ranging from 1ms to 65 seconds.

- Input ports can be viewed, enabled, and disabled from the video screen system.

- Output ports can be viewed, changed, enabled, and disabled from the video screen system.

- Input and output ports' status can be read, and the ports can be controlled from the serial interface.

NOTE: Use the input/output ports configuration screen under the "Configure" menu to set Port C to an input or output.

Detailed Port Description

Input/Output Port Locations

The user connects to the ports through three terminal blocks located on the controller circuit card. Their locations are shown in the following figure.
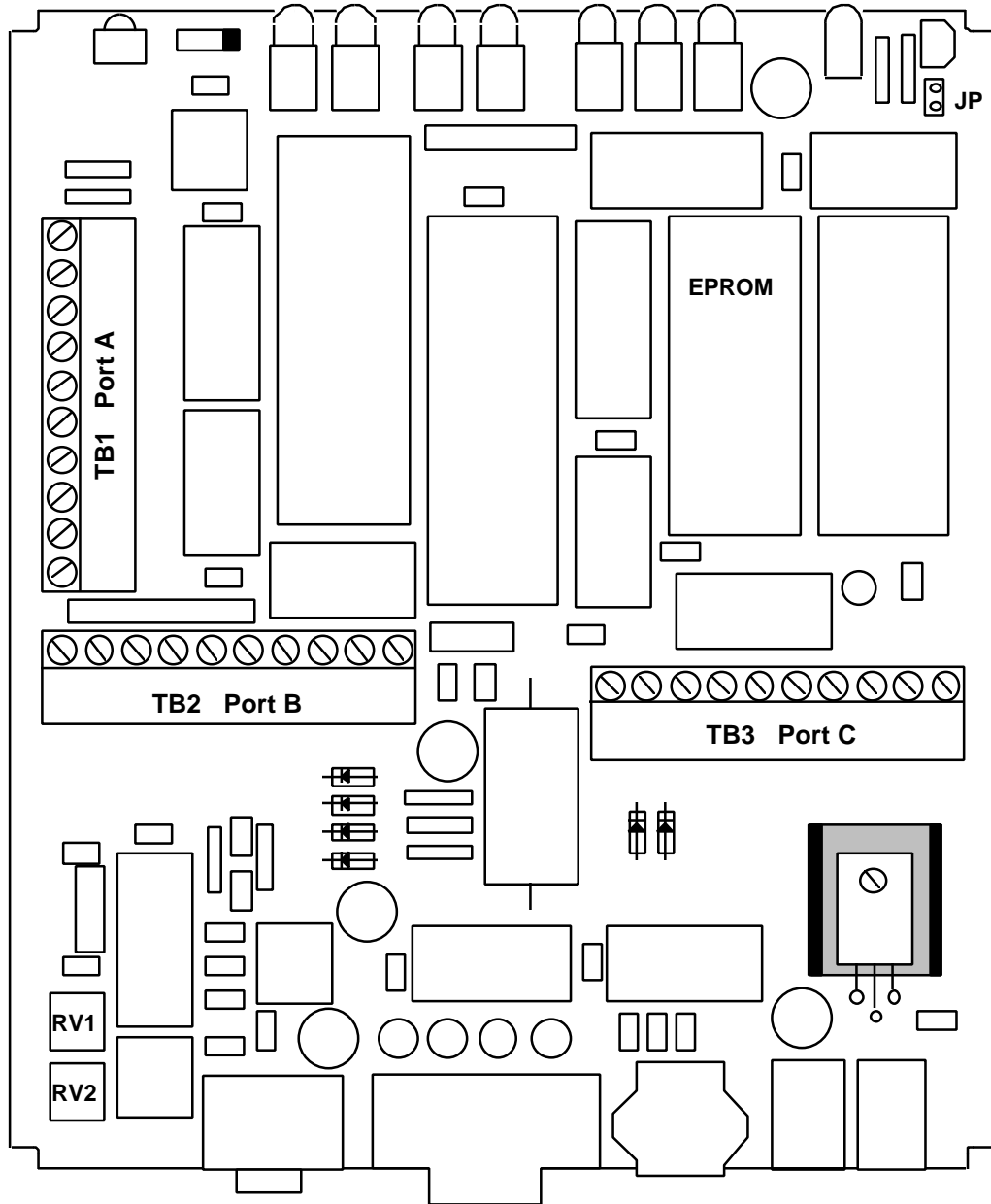
NOTE: Before using Port C, configure it for the selected mode (input or output) using the Input/Output Port screen under the "Configuration" menu.

Port A - Relay Drivers

Port A provides 8 open-collector outputs which can be used to drive relays, solenoids, LEDs, etc. The outputs have built-in suppression diodes to provide protection when driving inductive loads. An open-collector output driver acts similarly to a switch connected to an external power source. The output is always in one of two states:

- When turned "on", the output port is shorted to ground, allowing current (provided by an external source) to flow through the driver to ground, thereby powering an external device.

- When turned "off", the output port is opened, preventing current flow and turning the device off.

Terminal Block 1 (Port A) Description

Terminal Block 1 (Port A) contains a total of 10 lines for connecting to this port, as shown:

```
Terminal 10: Ground
Terminal 9: Port A Common
Terminal 8: Port A-8
Terminal 7: Port A-7
Terminal 6: Port A-6
Terminal 5: Port A-5
Terminal 4: Port A-4
Terminal 3: Port A-3
Terminal 2: Port A-2
Terminal 1: Port A-1
```
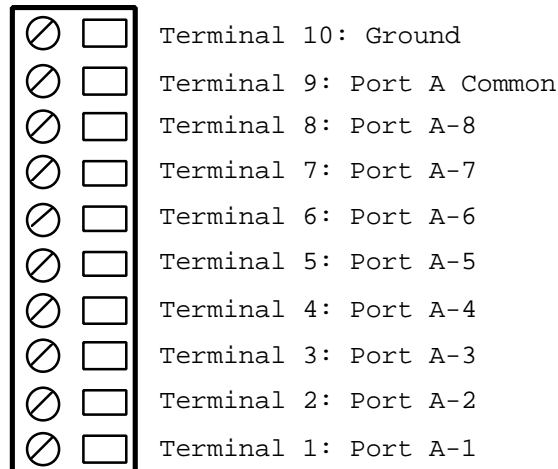
Terminals 1 - 8 are the outputs, and terminals 9 and 10 are connections that are common to all eight outputs. Each device connected to Port A requires at least two lines:

- One line to the desired port signal (terminal points 1 through 8).

- One line to ground (terminal point 10).

A third line can also be connected to the "common" signal (terminal point 9) to provide protection when driving an inductive load. Descriptions of when and how to use this feature are provided later.

Port A Electrical Characteristics

The Port A outputs are driven by an industry standard ULN2803A integrated circuit, which has the following electrical characteristics:

Absolute Maximum Ratings

Maximum Current (single output):	500 mA
Maximum Output Voltage:	50 V
Maximum Power Dissipation:	2 W

Electrical Parameters

Output Voltage Drop (Vce):   1.1V max at <100mA current
                                  1.3V max at 200mA current
                                  1.5V max at 300mA current
                                  1.7V max at 400mA current
                                  1.9V max at 500mA current

NOTE: When multiple outputs are on simultaneously, the total current must be limited to keep the power dissipation below 2 Watts. The power dissipation for each output is calculated by multiplying its current by the voltage drop shown in the table above.

Example:

Output 1 drives 400mA. 400mA X 1.7V drop = 680mW power.
Output 2 drives 400mA. 400mA X 1.7V drop = 680mW power.
Output 4 drives 200mA. 200mA X 1.3V drop = 260mW power.
Output 7 drives 100mA. 100mA X 1.1V drop = 110mW power.

The total power is 1730mW, which is OK since it's less than 2W.

Port A Examples

A few examples will best illustrate how to connect to Port A. The following diagram shows output port A-1 driving an external DC relay:
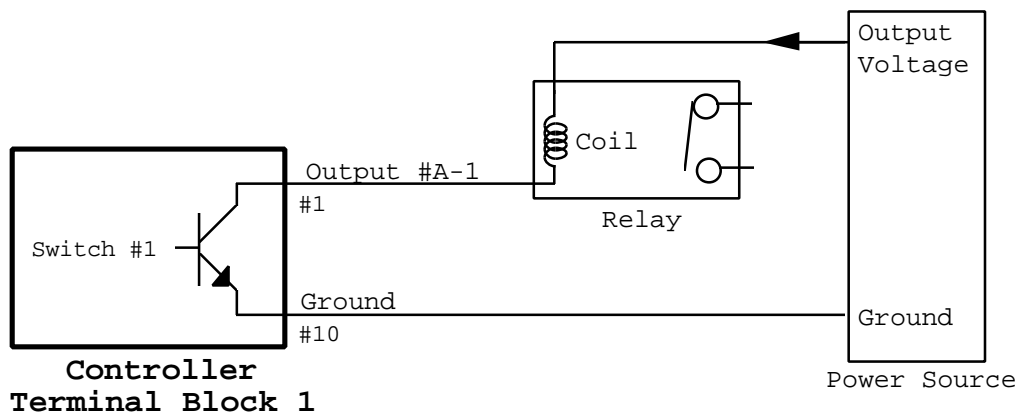
One side of a relay coil is connected to the positive side of an external DC power source. The other side of the coil is connected to the chosen output port of the controller (in this case, Port A-1). The ground from the external power source is connected to the controller's ground (terminal block point #10).

The diagram of the controller shows a transistor (Switch #1). When the output port is "off", the transistor is open-circuited, preventing current flow from the output to ground. Thus, no current flows through the relay coil and the relay is de-energized.

When the controller's output port is turned "on", the output point (#1) is shorted to ground (point #10). This allows current to flow from the external power source, through the relay coil, into controller port A-1, out through the ground (#10), and finally into the ground of the external power source. This energizes the relay causing it to switch.

This same approach could also be used to drive a Light Emitting Diode (LED) by connecting the LED in series with a current-limiting resistor in place of the relay coil.

Adding Transient Suppression

One problem with the configuration shown above occurs when driving inductive loads like relays. When the output is turned off, the current must stop flowing through the relay coil. The coil, like all inductors, reacts by sharply increasing the voltage across it. Some relays have built-in transient suppression diodes which clamp this transient voltage spike to a safe level. Without protection, the power source or the driver circuit could be damaged by the spike.

The ULN2803A contains built-in suppression diodes to prevent this problem, eliminating the need for external suppression diodes. To take advantage of this, the power source driving the relay must be connected to the "common" terminal of the output port (terminal point #9), as shown:
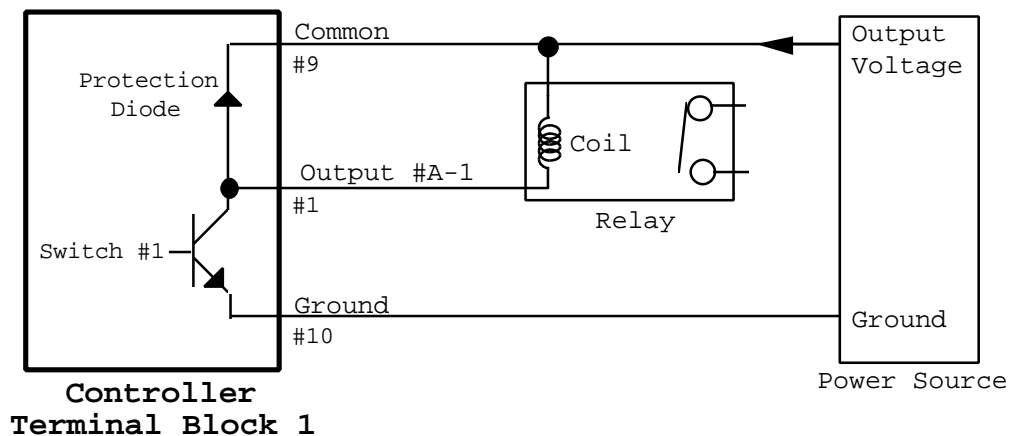
With this set-up, the protection diode prevents the coil voltage from exceeding the normal power source's output voltage (plus a 0.7V diode drop), eliminating the possibility of damage.

WARNING: It is strongly recommended that the connection to point #9 be made for any relay (or other inductive load) which doesn't contain its own suppression diode. This will prevent damage to the load and the controller.

External Power Source

As shown in these figures, the drive current for Port A must be provided from an external power source. Why wasn't the controller designed to provide this power itself?

There are many different types of relays available requiring different amounts of drive current and voltages. Common DC coil voltages range from 3VDC to 48VDC,. It would be impossible to design the controller to provide all of these voltages.

Instead, the controller is designed to interface to an external source which provides the specific voltages required for the chosen relays. If you're planning to use Port A, you'll need to provide your own DC power source. Naturally, it would be most convenient to select the same coil voltage for all the relays (or other devices), allowing the use of a single power source.   Inexpensive wall

transformers are available to provide up to 1 Amp at common voltage levels. AC power sources or relays should not be used.

Multiple Port A Connections

When connecting multiple devices to Port A, the devices can share the same common and ground connections, thereby minimizing the number of wires which must be run. This diagram illustrates connecting eight relays to Port A:
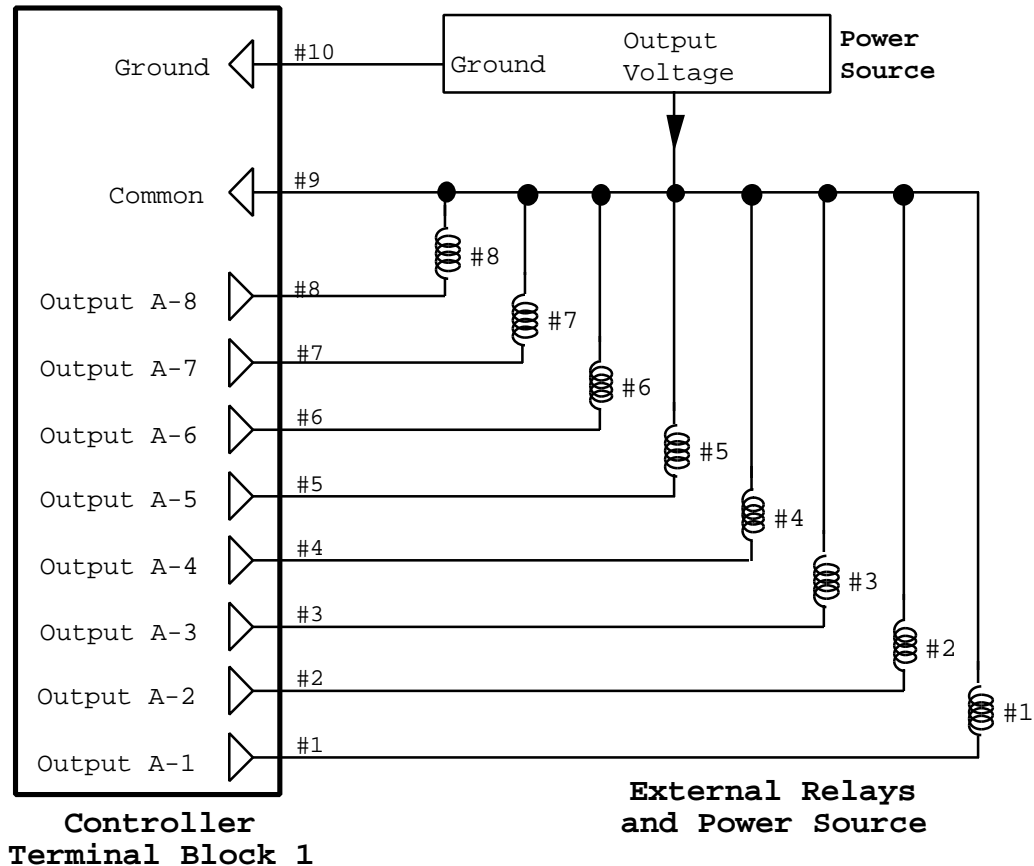
Since the coils of all the relays are tied together, this approach requires that the coils have the same voltage rating. It's possible to use relays with different coil voltages, but then they cannot be tied together at the "common" connection. This takes away the transient suppression provided by the protection diodes, so external suppression diodes should be provided (preferably built into the relays themselves).

As another example, the following setup can control several different types of devices simultaneously.

**Controller
Terminal Block 1**

External Devices
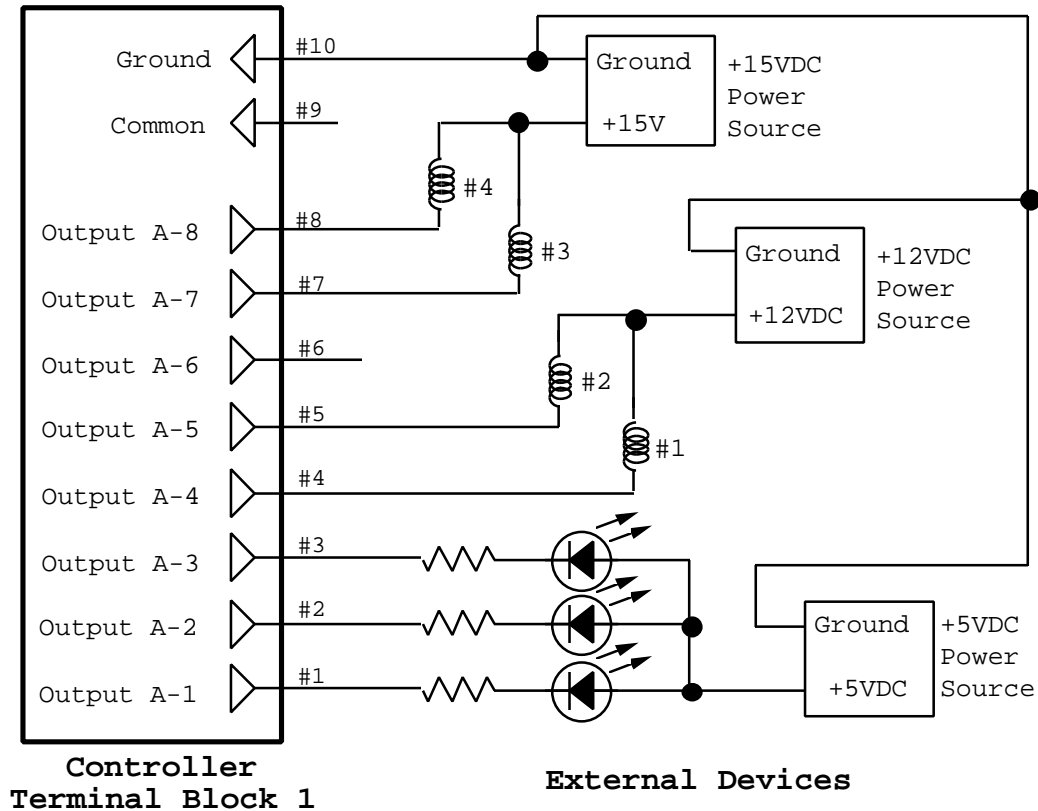
In this example:

- Two relays (#3 and #4) are being driven from a 15 VDC power supply using ports A-7 and A-8.

- Two other relays (#1 and #2) are being driven from a 12 VDC power supply using ports A-4 and A-5.

- Three LEDs are being driven with a 5 VDC power supply using ports A-1, A-2, and A-3.

> **WARNING: Its important to note that no connection is made to the "common" port in this example. When using multiple power sources, do not make any connections to the common port (terminal point #9). The common point ties all of the output ports together through the suppression diodes. Tying them together in this example could result in the power sources shorting to each other.**

Port B - Digital Inputs

Port B provides 8 inputs which are protected up to +/-30V. They are "digital" inputs because they are read as a one or zero. They contain pull-up resistors allowing them to be directly connected to switch closure inputs. Here are some devices that can be connected to this port:

- Magnetic switches (used in alarm systems)
- Motion sensors
- Glass break detectors

- Smoke alarms (some types)
- Water level detectors
- Radon detectors (some types)
- Push button switches
- Thermal switches
- Thermostats (isolated)
- TV on/off sensors
- Any other switch (or relay)

These inputs can also directly read TTL or CMOS digital inputs if you want to interface to your own circuitry.

Terminal Block 2 (Port B) Description

Terminal Block 2 contains a total of 10 lines for connecting to this port, as shown:

```
Terminal 10: Ground
Terminal 9: Ground
Terminal 8: Port B-8
Terminal 7: Port B-7
Terminal 6: Port B-6
Terminal 5: Port B-5
Terminal 4: Port B-4
Terminal 3: Port B-3
Terminal 2: Port B-2
Terminal 1: Port B-1
```
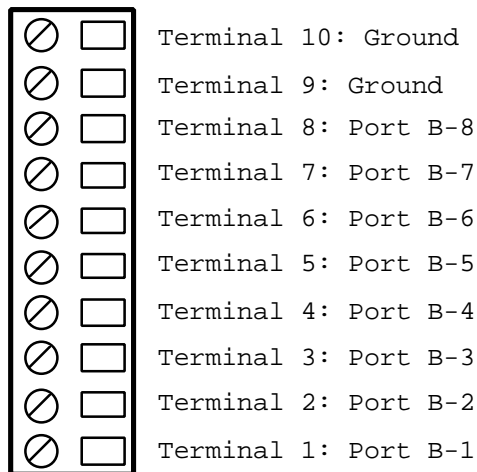
Terminals 1 - 8 are the inputs, and terminals 9 and 10 connect to the controller's ground.

There are many types of equipment with outputs that are simple switches or relays. When the switch or relay is closed, an electrical circuit path is made across it. When opened, there is no circuit path. Wires connected to these outputs can be connected to the inputs of Port B. These devices are connected to Port B by attaching one wire to the desired input port and the other to one of the ground points.

Port B Electrical Characteristics

The Port B inputs interface to an industry standard 75C189 (or equivalent) integrated circuit, which has the following electrical characteristics:

Absolute Maximum Ratings

Maximum Input Voltage: +/-30 VDC (AC voltages should not be applied)

Electrical Parameters

Voltage inputs of -30V to +1V are read as zero (low)
Voltage inputs of 1.3V to 30V are read as one (high)

Voltage inputs between 1.0V and 1.3V are indeterminate.

If the input is left open, it will be "pulled-up" to 5V and read as a one (high).

A schematic of one input is shown below including a 2.7K pull-up resistor located on the controller circuit board.

**Controller
Terminal Block 2**
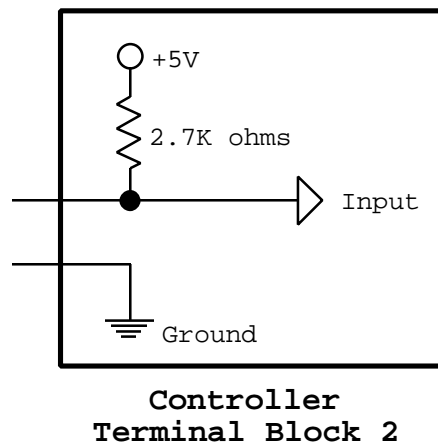
Port B Examples

A few examples will best illustrate how to connect to Port B as an input. The following diagram shows input port B-1 connected to an external switch:

**Controller
Terminal Block 2**
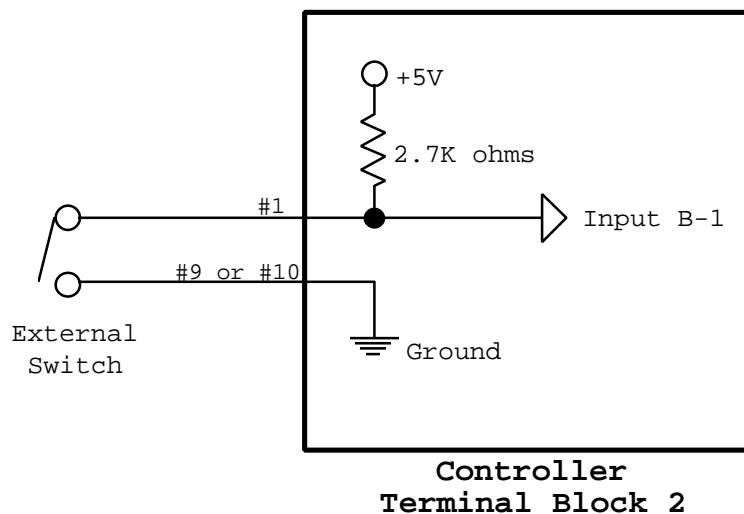
When the switch is open, no current flows through it. The input buffer is internally pulled to +5V by the built-in resistor. Thus, the controller will read the input as "High" (a logic 1).

When the switch is closed, current will flow through it and pull the input buffer down to ground. Thus, the controller will read the input as "Low" (a logic 0). The table below summarizes the current flow and voltage levels for the opened and closed positions.

	External Switch Position	
	Open	Closed
Current Flow Through Switch :	0 mA	1.8 mA
Voltage at Input Buffer :	+ 5 V	0 V
Controller Input Port State :	High (1)	Low (0)

NOTE: For proper operation, the resistance of the external switch and wiring to the controller should be less than 500 ohms. This should not pose any problems, as even long wiring should have well under 100 ohms resistance.

When multiple switches are used, one end of each switch should be tied together as a common ground, as shown:
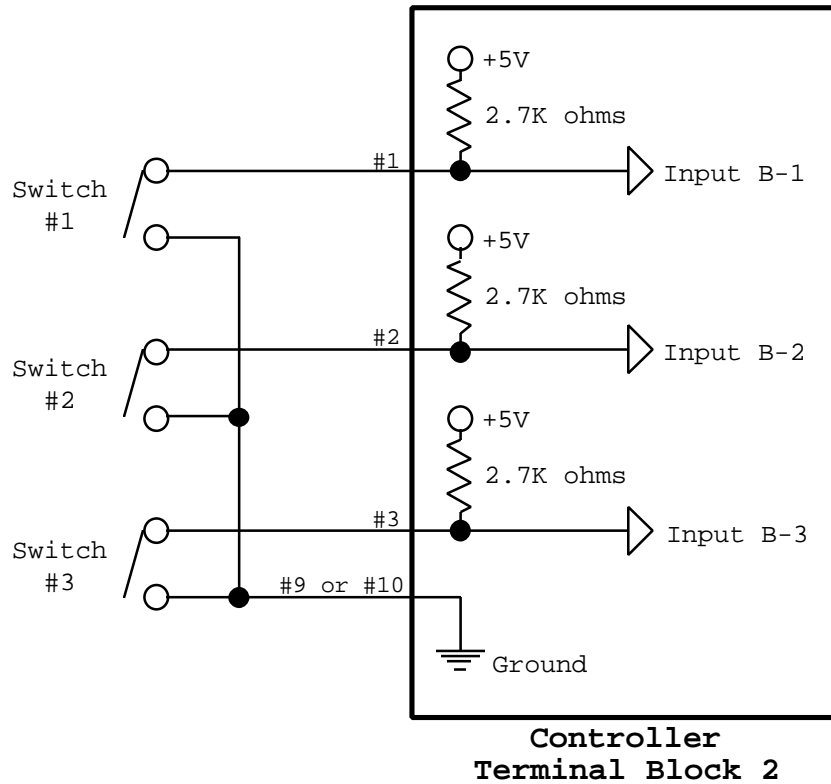
Controller
Terminal Block 2

Port B can also be used as an input from a 5V digital circuit, as shown in the following circuit. The common ground is necessary to ensure consistent voltage levels are used by the two systems.

External   **Controller**
Device   **Terminal Block 2**
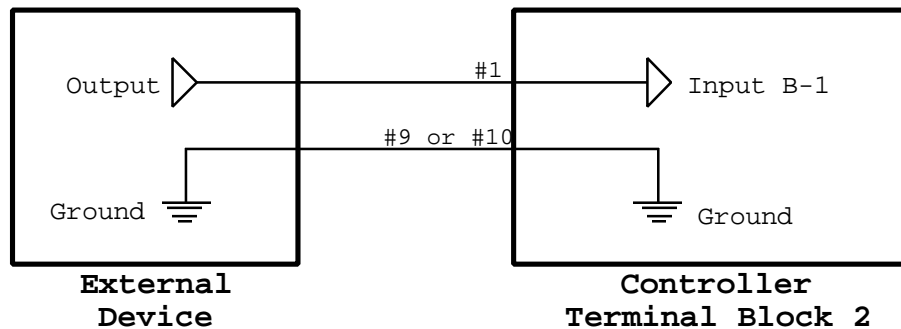
Port C - Digital Input/Output

Port C is connected to a PCF8574 integrated circuit which provides eight interface lines. The port can be configured as an input or output port (all 8 lines will be the same type). When used as an input, it can connect directly to switch-closure type devices (just as with Port B), or to digital signals. As an output, it can directly drive digital logic or lower power peripherals such as LEDs (up to 20mA current).

WARNING: Before making any hardware connections to this port, the controller must be set to the desired mode (input or output). This is done using the I/O port configuration screen of

the PC program. If you configure port C as an output, but connect input devices to it, damage to the controller or the external devices could result.

Terminal Block 3 (Port C) Description

Terminal Block 3 contains a total of 10 lines for connecting to this port, as shown:

```
Terminal 10: Ground

Terminal 9: 5V

Terminal 8: Port C-8

Terminal 7: Port C-7

Terminal 6: Port C-6

Terminal 5: Port C-5

Terminal 4: Port C-4

Terminal 3: Port C-3

Terminal 2: Port C-2

Terminal 1: Port C-1
```

All digital inputs and outputs are referenced to the controller's ground. This ground is brought out to terminal point 10 and must be connected to the ground of the interfacing devices. Terminal point 9 is connected to the controller's regulated +5V power supply. This point can provide up to 100mA of continuous current (160mA peak) to external devices.

Using Port C as an Output Port

When used as an output port, Port C provides the following output voltages (per line):

OUTPUT STATE	OUTPUT VOLTAGE	MAXIMUM CURRENT
High - Logic 1 (One)	>=4.8 V	300 uA
Low - Logic 0 (Zero)	<=1 V	20 mA

WARNING: It's important to follow the current limits in this table, as exceeding them could damage the PCF8574. Note that the output can sink much more current in the low state (20mA) than it can provide in the high state (300uA). This is important to remember when driving medium current devices like LEDs. The examples given in this manual show the proper way to drive such devices.

Port C Output Examples

A few examples will best illustrate how to connect to Port C as an output. The following diagram shows output port C-1 driving an LED:
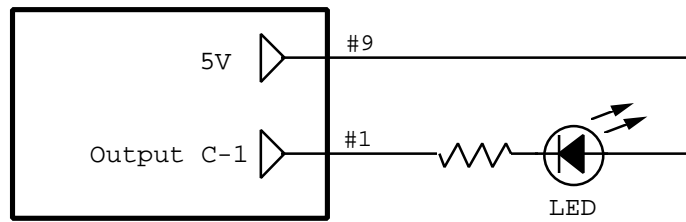
This example shows a resistor in series with an external LED. The resistor is necessary to limit the current through the diode to less than 20mA. A resistor between 250 ohms and 1000 ohms should work fine. When the output is low, current will flow and the LED will light. When the output is high, the LED will be off.

NOTE: When using Port C as an output, no external power source is necessary. This is different than Port A, which requires external power.

Port C can also provide digital outputs to external circuitry. The following example shows Port C driving a standard CMOS latch (74HC373):
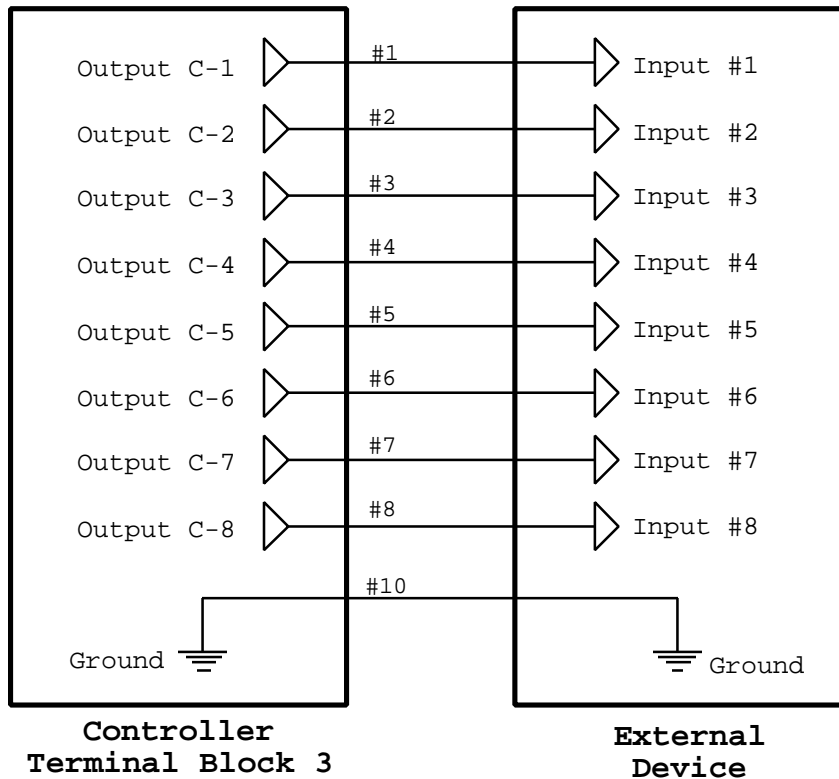
The eight controller outputs are connected to the eight inputs of the latch. Also, the ground of the external circuit must be connected to the controller's ground (point 10).

When the controller is outputting a high (logic 1) signal, the voltage will be a minimum of 4.8V. When outputting a low, the voltage will be a maximum of 1V. These levels are compatible with both CMOS and TTL circuits and can be read by the 74HC373 (or any other digital integrated circuit for that matter).

Using Port C as an Input Port

When used as an input port, Port C interprets the voltage at the terminal block based on the following levels:

• Voltage >= 3.5 V is read as a high (1)

• Voltage <= 1.5 V is read as a low (0)

• Voltages between 1.5 and 3.5 are indeterminate and may be read as a high or low (and should therefore not be used).

• Voltages > 6 V or less than 0 V (i.e., negative voltages) exceed the maximum rating of the PCF8574 integrated circuit and should not be applied. If you have inputs that can exceed this range, connect them to Port B which can withstand up to +/-30V.

• An open input will be pulled up by the PCF8574 and read as a high (1). This facilitates the use of switch closure inputs which are either closed or opened. However, external devices can easily override the pull-up when they drive the port low or high. Thus, Port C will work with standard digital inputs as well as switch closure inputs.

> **WARNING: As noted above, input voltages into Port C are limited to between 0V and 6V. Voltages outside this range could damage the controller. If you have inputs that can exceed this range, connect them to Port B instead.**

Port C Input Examples

A few examples will best illustrate how to connect to Port C as an input.

The PCF8574 easily interfaces with switch closure inputs of the type found in burglar alarm sensors, motion sensors, water-level sensors, etc. Switch closure inputs can be used with Port C in a similar fashion to Port B. This example shows connecting an external switch to Port C-1:

**Controller
Terminal Block 3**
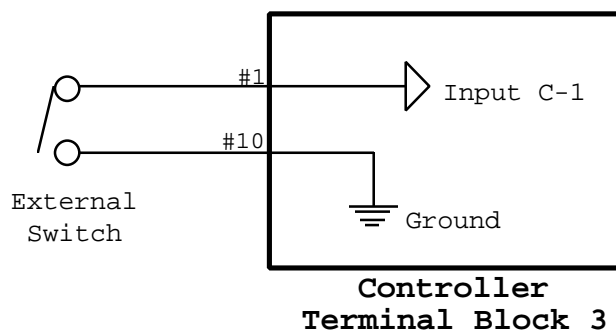
> NOTE: No pull-up resistors are used on Port C. However, the PCF8574 interface device on Port C contains an internal "weak" pull-up. If the input is left open, it will be pulled-up to 5V. However, if the input is grounded, the ground will over-power the pull-up, bringing the input to ground.

When the switch is open, no current flows through it. The input buffer is internally pulled high in this condition. Thus, the controller will read the input as "High" (a logic 1).

When the switch is closed, current will flow through it and pull the input buffer down to ground. Thus, the controller will read the input as "Low" (a logic 0).

Port C can also be used as an input from a 5V digital circuit, as shown in the following circuit. The common ground is necessary to ensure consistent voltage levels are used by the two systems.

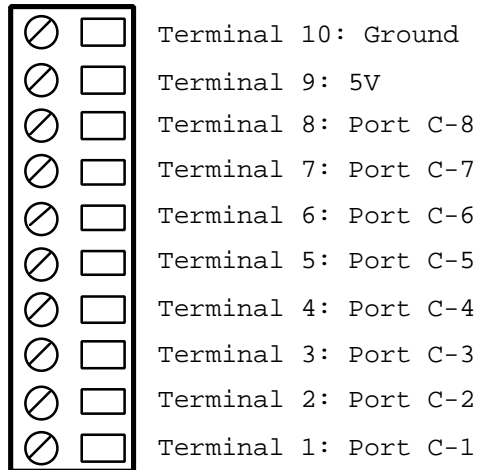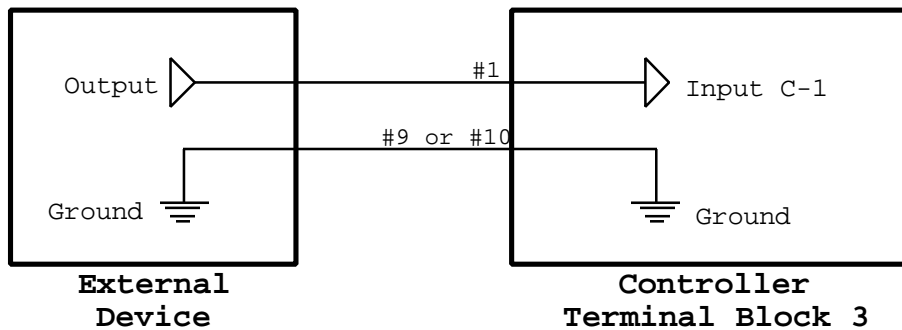You can also mix and match switch closure inputs with digital inputs, as shown in this example:

External Devices   **Controller Terminal Block 3**
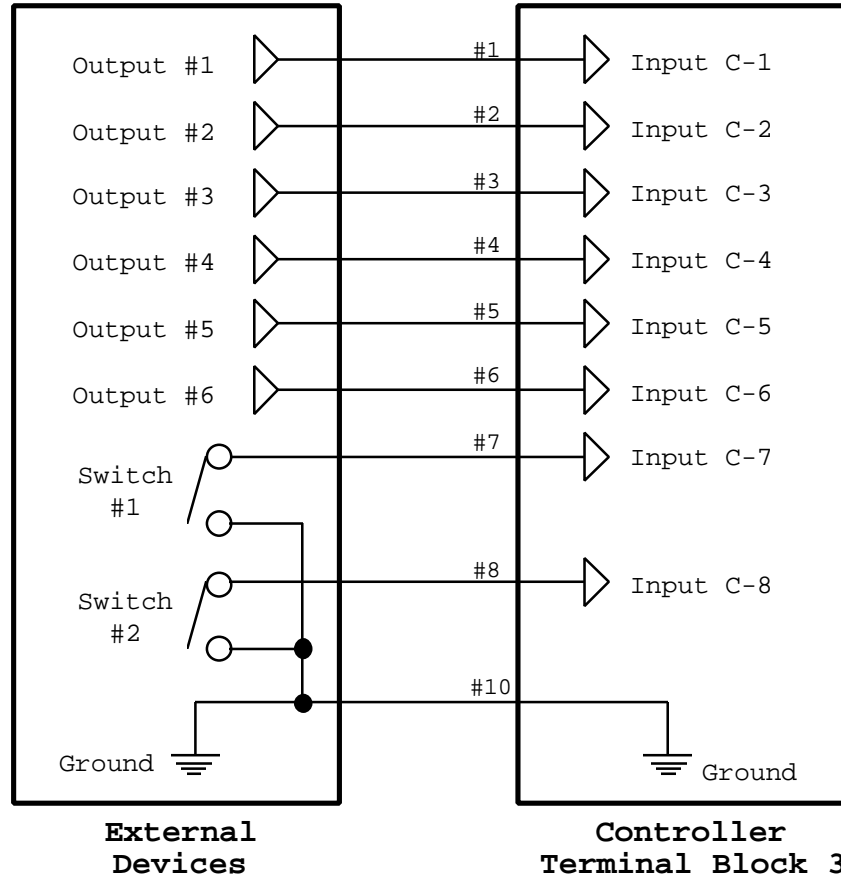
Control Of Output Ports

Output ports can be controlled in two ways:

- By a command received over the serial interface. If a computer is connected to the serial interface, it can directly control all of the outputs.

- By the video screen system and an infrared remote.

This section describes the commands that can be used and gives examples.

Output Port Commands

```
Set Output Port Low
```

Sets the output port to a low (logic zero) state. Ports A and C use different hardware drivers and therefore their low (logic zero) states will be slightly different:

Port A: The output will be turned off, resulting in an open circuit (output is not driven high or low, but is disconnected). External devices such as relays will therefore be off (not driven).

<u>Port C:</u>   The output will be driven low with a voltage <= 1V.

`Set Output Port High`

Sets the output port to a high (logic one) state. Ports A and C use different hardware drivers and therefore their high (logic one) states will be slightly different:

<u>Port A:</u>   The output will be turned on, resulting in the output being shorted to the ground connection on the terminal block (point #10). This allows current to flow through the circuit, driving the external device.

<u>Port C:</u>   The output will be driven high with a voltage >= 4.8V

`Toggle Output Port`

Switches the output port to the opposite of its current state. A high output will go low and a low output will go high.

`Pulse Output Port Low For "##.###" Seconds`

Sets the output port to a low state for "##.###" seconds, then sets it high. "##.###" can range from 0.001 to 65.535 seconds. This command is normally used when an output is high. It will "pulse" the output low for the specified period of time. If the output is low when the command is executed, it will stay low for the specified time, then go high.

This command is designed primarily for controlling devices which require relatively short duration, precise pulse widths. Although long lengths are possible, it's best to keep them to a few seconds or less.

When this command is executed, the controller sets the port to the desired state, then waits for the specified time to elapse. While waiting, it will still be able to receive X-10 and infrared signals. However, it will not immediately report them. Only after the port command is complete will it respond to any signals which came in during the wait.

NOTE: Since the controller doesn't perform other actions while executing this command, it is recommended that it only be used for short pulses. Pulses of a few seconds or less are sufficient to control most devices that use pulses as commands.

`Pulse Output Port High For "##.###" Seconds`

Sets the output port to a high state for "##.###" seconds, then sets it low. "##.###" can range from 0.001 to 65.535 seconds. This command is normally used when an output is low. It will "pulse" the output high for the specified period of time. If the output is high when the command is executed, it will stay high for the specified time, then go low.

Please refer to the previous command for several important notes about these "pulse" commands.

`Disable Output Port`

Disables the output port. After an output is disabled, the only command that can be executed is an Enable command. Other commands, such as to set the output high or low, will be ignored. After being enabled again, it will work normally. Each output port can be individually enabled or disabled at any time.

```
Enable Output Port
```

Enables the output port. This command must be issued to a "Disabled" output before it will respond to any other command.

```
Read Output Port State
```

Transmits the current state of the port over the serial interface.

```
Set 8-Bit Port "X" To "YYYYYYYY"
```

"X" can refer to either Port A or Port C (if Port C is configured as an output). This command sets all 8 lines in the port simultaneously. "YYYYYYYY" represents the desired states of the 8 lines, with the highest port number being listed first. For example:

```
Set 8-Bit Port C To 10001111
```

will set the 8 lines of Port C as follows:

Port C-1 = 1 = high
Port C-2 = 1 = high
Port C-3 = 1 = high
Port C-4 = 1 = high
Port C-5 = 0 = low
Port C-6 = 0 = low
Port C-7 = 0 = low
Port C-8 = 1 = high

This command is useful if you're using Port C as an interface to a digital circuit with an 8-bit bus. A single command will write a "byte" to the bus.

Control Of Input Ports

Input ports can be controlled in two ways:

- By a command received over the serial interface.

- By the video screen system and an infrared remote.

This section describes the commands that can be used.

Input Port Commands

```
Disable Input Port
```

Disables the input port. When an input is disabled, the controller will not check the port state or update its value. However, you can still read the port's state over the serial interface. After being enabled again, the port will work normally.

```
Enable Input Port
```

Enables the input port. This command must be issued to a "Disabled" input before it can be used normally.

Read Input Port State

Transmits the current state of the port over the serial interface.

CHAPTER 6: VIDEO OUTPUT

Introduction

The video interface provides the following features and capabilities:

- Can display predefined menus and screens on a television. These menus allow you to view the status of and issue commands for X-10 modules, input/output ports and IR signals.

- Can display custom screens that you create.

- Screens are 11 rows of 24 characters each (actually, the controller can generate 12 rows, but most televisions can only display 11).

- Each row can be individually set to one of 4 character sizes.

- Individual characters can be made to blink. Three different blink rates are available.

- Text can be displayed over solid background or overlayed on top of incoming video. When a solid background is used, you can select from eight different background colors.

- Incoming video can be passed through without any overlay.

- The video screen system can be controlled from a standard hand-held infrared remote control.

- The entire video system can be controlled from the serial interface.

- The standard video format is NTSC. PAL video is available as an option (it requires a modified controller card).

Video Screen System

The controller contains numerous built-in screens that can be displayed at any time. You can move between screens with an infrared remote.

The best way to learn about the video screen system is by displaying it on your TV and moving through it with your infrared remote control. To do this, you'll first need to configure your remote to work with the controller. Refer to the infrared control chapter for information on how to do this.

This section explains the key features of the video screen system.

Video Screens Overview

The screens are grouped into four general categories:

- **Main Menu**. There is a one page "main menu".

- **Object List Screens**. These screens list the objects in your schedule in the order of their ID numbers. There are separate screens for X-10, IR signals, input ports, and output ports. The screens list 8 objects at a time, displaying their names and other information. You can scroll through them to view their status and make changes. Pressing an object's number key on your remote takes you to the object control screen.

- **Object Control Screens**.   These screens allow you to make changes to or control the selected object. For instance, you can:

    - Transmit an X-10 signal
    - Transmit an infrared signal
    - Control an output port

    These object control screens are organized as menus, allowing you to easily select the desired action. They also have help screens.

- **Help Screens**. Some of the screens have help screens that explain important features.

Video Screen System Navigation

An infrared remote control is used to navigate around the video screens. 16 buttons (keys) are used for this purpose:

- Number keys 0 - 9
- Volume up and down keys
- Channel up and down keys
- Enter key
- Cancel key

Your remote may not use these exact names for the keys (particularly a Cancel key). This isn't a problem, as you can assign these functions to any buttons on your remote. Refer to the infrared control chapter to properly configure your remote for operation with the video screen system.

The remote control's buttons have different functions depending which video screen is active (being displayed). The functions are explained below.

- **No Display**. When the video screen system is inactive, no screens are being displayed. The only remote key that functions automatically is channel up, which starts the video screen system and displays the main menu.

- **Main Menu**. When the main menu screen is being displayed, use the number keys to select from the menu entries.

- **Object List Screens**. When one of the object list screens is being displayed, the keys have these functions:

    - Number keys select specific objects from the list.
    - Volume up and down keys page through the objects. Volume up displays objects with higher ID numbers, while volume down displays objects with lower ID numbers.
    - The channel up key returns you to the previous menu.
    - The channel down key exits from the video screen system and shuts off the On Screen Display circuitry.
    - The enter and cancel keys are not used.

- **Object Control Screens**. When one of the object control screens is being displayed, the keys have these functions:

  - Number keys select from the menu entries.
  - The channel up key returns you to the previous screen (object list screen).
  - The channel down key exits from the video screen system and shuts off the On Screen Display circuitry.
  - The volume up and down, enter, and cancel keys are not used.

- **Event Log Screen**. When viewing this screen, the keys have these functions:

  - Channel up and down keys move up and down 1 screen (9 lines) at a time.
  - Volume up and down keys move 1 line at a time.

    NOTE: Once you reach the top (oldest events) or the bottom (newest events), you can't go any further.

  - The enter and cancel keys are used to return to the main menu.

- **Weather Conditions Screen**. All keys return you to the main menu.

- **Help Screens**. From the help screens, all keys return you to the previous screen.

Starting the Video System

There are two ways to start displaying screens:

1) Pressing the "Channel Up" button on your configured remote.

2) Performing this command:

    ```
    Start Video Menu System
    ```

These start the video screen system and display the main menu.

Stopping the Video System

There are three ways to stop displaying screens:

1) Many of the built-in video screens allow you to shut the system off. Some screens have this option on the menu and you simply press the corresponding button on your remote. Other screens use the "Channel Down" button to exit.

2) Remove power from the controller then re-apply power.

3) Use the "Stop Video Mode" command.

If you desire, you can prevent the user from turning the video system off. To do so, select this option from the "Controller Settings" screen's "Other" tab. When this option is selected:

- If the user tries to exit the video menu system using an IR remote, the command is ignored and the screen remains unchanged.

- When learning an infrared signal, the video system will be temporarily shut off. When learning is complete, it will be restarted.

- When power is restored to the controller, it automatically starts the video menu system.

- You can still shut off the video system by using the "Stop Video Mode" command over the serial interface if you desire.

Event Log

The event log can record the occurrence of events and can be viewed on your TV. The log holds 256 lines of data in a "scrolling" fashion. New events are added at the bottom of the list. Once all 256 lines are filled, the new data overwrites the oldest data. Thus, the 256 most recent lines are always displayed.

Some types of events can be automatically written to the log. You can control what's logged using the Controller Settings screen under the "Configure" menu of the PC software.

Weather Conditions Screen

The TV menu system contains a screen for viewing weather conditions, which is described in a separate chapter.

Video Commands

The video commands are divided into these groups:

- Configuration Commands
- Control Commands
- Text Commands
- Event Log Commands

Video Configuration Commands

These commands initialize the video system and control its major operating modes. When you want to display video data or text, use these commands first to get things set up.

There are four primary commands that should serve most of your needs:

```
Start Video Menu System
Start Internal Video Mode
Start External Video Mode
Stop Video Mode
```

There are multiple settings that must be made to use the video system. These commands configure them all in the quickest fashion. The individual settings can be adjusted with other commands that will be described following these commands.

Start Video Menu System

This command starts the video screen system and displays the main menu. It performs the following actions to do this:

- Turns the On Screen Display (OSD) circuitry on.

- Sets the OSD to the internal video position.

- Sets the video switch to the OSD position.

- Sets the background color to its default setting.

- Sets the horizontal and vertical screen offsets to their default settings.

- Sets the screen blink ratio to 3:1.

- Displays the main menu screen.

This command is the quickest way to start the video screen system.

Start Internal Video Mode

This command sets the controller up to display video text overlayed onto internal video (a solid background). It performs the following actions:

- Turns the On Screen Display (OSD) circuitry on.

- Sets the OSD to the internal video position.

- Sets the video switch to the OSD position.

- Sets the background color to its default setting.

- Sets the horizontal and vertical screen offsets to their default settings.

- Sets the screen blink ratio to 3:1.

- Displays video screen #0, which is a blank screen that you can use to create your own screens.

- Clears the video screen.

You might use this command when you want to display your own custom video screen on a solid background. After you perform this command, you can immediately start adding text, and it will be automatically displayed.

Start External Video Mode

This command sets the controller up to display video text overlayed onto the incoming video signal. It performs the following actions:

- Turns the On Screen Display (OSD) circuitry on.

- Sets the OSD to the external video position.

- Sets the video switch to the OSD position.

- Sets the horizontal and vertical screen offsets to their default settings.

- Sets the screen blink ratio to 3:1.

- Displays video screen #0, which is a blank screen that you can use to create your own screens.

- Clears the video screen.

You might use this command when you want to display your own custom video screen or other text on top of the incoming video. After you perform this command, you can immediately start adding text, and it will be automatically displayed.

Stop Video Mode

This command performs the following actions:

- Turns the On Screen Display (OSD) circuit off.

- Sets the video switch to the external video position.

This is the simplest way to shut off the video screen system when not using it.

Set Video Switch To External Video Position
Set Video Switch To On Screen Display Position

The video switch switches the video output jack between the incoming video signal (called the external video source) and the On Screen Display (OSD) video source. Figure 13-1 shows the operation of the video system and where the video switch fits in.

In the external position, the signal at the video input jack will be fed directly to the video output jack, bypassing the OSD. You should put the switch into this position when you do not want to display any video screens.

In the On Screen Display position, the signal from the OSD will be fed to the video output jack. The video switch must be in the OSD position when you want to display any video screens. Note that in order to display video screens, you must also turn the OSD circuitry on, which is a separate command.
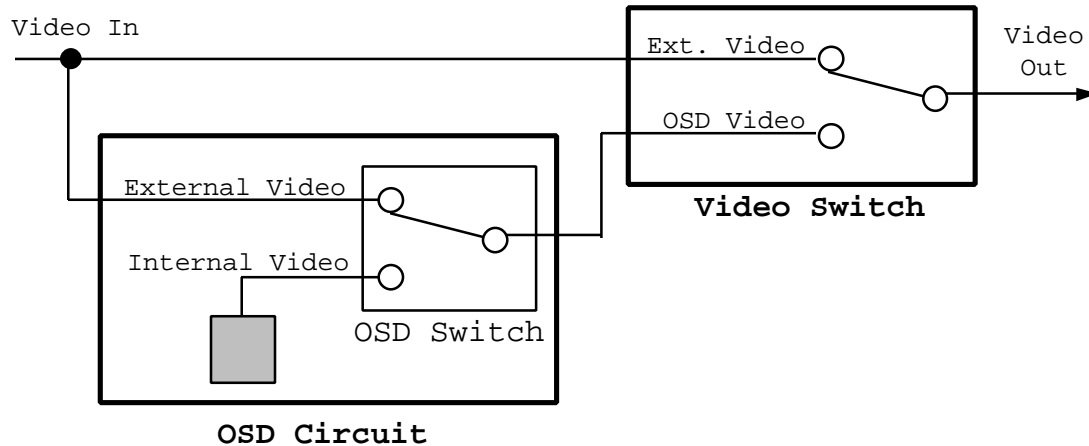
Figure 13-1   On Screen Display Switch Positions

You can change the video switch position any time you wish, regardless of what, if any, data you're displaying. You can also change its position while displaying the video menu system. This allows you to quickly switch between the menu system and external video.

```
Turn On Screen Display On
Turn On Screen Display Off
```

These commands turn the On Screen Display (OSD) control circuitry on or off. It must be turned on before you can display video screens. When you're not displaying video screens, you should turn it off to conserve power. When it's off, you cannot display any video screens, but you can still display external video by putting the video switch in the external position.

You do not need to use these commands if you use the Start Video Screen System, Start Internal Video Mode, Start External Video Mode, and Stop Video Mode commands. Those commands will automatically turn the OSD circuitry on or off as required.

```
Set OSD To Internal Video Background
Set OSD To External Video Background
```

This is a switch internal to the On Screen Display (OSD) circuitry that selects the background on which the text will be displayed (see the switch labeled "OSD Switch" in Figure 13-1). In the "Internal" position, the text will be displayed over a solid background (internally-generated video). You can choose from eight background colors. In the "External" position, the text will be displayed over the incoming video at the video input jack. If you set the OSD to this position and there's no video coming in, there will be no display.

You do not need to use these commands if you use the Start Video Screen System, Start Internal Video Mode and Start External Video Mode commands. Those commands will automatically put the OSD circuitry into the proper position. However, you can use these commands to switch between internal and external video overlay any time you wish.

```
Initialize OSD Circuits
```

This command initializes the On Screen Display (OSD) circuitry to the following settings:

- Turns the On Screen Display (OSD) circuitry on.

- Sets the OSD to the internal video position.

- Sets the background color to its default setting.

- Sets the horizontal and vertical screen offsets to their default settings.

- Sets the screen blink ratio to 3:1.

You do not need to use this command if you use the Start Video Screen System, Start Internal Video Mode and Start External Video Mode commands. Those commands will automatically initialize the OSD circuitry.

```
Set Horizontal Screen Offset To ##
Set Vertical Screen Offset To ##
```

These commands shift the location of the On Screen Display on your television screen. They are preset to the values that work for most televisions we've tested. However, if the screen is off-center on your TV, you can adjust the location with these commands.

Both offsets can range in value from 0 to 31. Zeros put the OSD in the upper left corner of the screen. On most televisions, this will put the upper left corner of the OSD slightly out of the picture. Increasing the horizontal value shifts the OSD to the right. Increasing the vertical value shifts the OSD down. Values near 30 will usually shift the OSD completely off the screen.

While this command is normally used only to center the OSD, it can serve other uses. For example, by executing commands in succession to increase the offset, the display can be made to "roll off" the screen either down or to the right.

Video Control Commands

```
Display Video Screen ##
```

Each of the built-in screens has its own number. You can use this command to directly display any of these screens without going through the menu system. The built-in screens are numbered starting at 1.

Video screen number 0 is a blank screen which you can use to create your own screen. Any time you want to make your own screen, you should first use this command to select video screen 0. You can then use the other commands to display text on it.

Screen numbers are as follows:

```
0   = Blank screen
1   = Outputs ports control screen
3   = Input ports list
4   = Main menu
5   = Output ports list
6   = IR signals list
```

```
    7  = X-10 signals list
    8  = Main menu help page 1
    9  = X-10 control screen
   12  = IR control screen
   15  = Main menu help page 2
   17  = Outputs ports help
   29  = IR help
   47  = X-10 help
   56  = Event log
   59  = Weather data
```

```
Set Default Screen Background To Black
Set Default Screen Background To Blue
Set Default Screen Background To Green
Set Default Screen Background To Cyan
Set Default Screen Background To Red
Set Default Screen Background To Magenta
Set Default Screen Background To Yellow
Set Default Screen Background To White
```

When you're displaying text over internal video (a solid background), you can choose from one of eight background colors. When you first set the OSD to internal mode (either with the Start Video Screen System, Start Internal Video Mode, or the Set OSD To Internal Video Background command), the background will be set to its default color. This command sets the default color. This default setting is maintained after you stop displaying video and even through power failures.

We recommend that you choose your preferred background color and make it the default color. This way you won't need to set it every time you start displaying text. The controller is initially configured with blue as the default color.

```
Set Current Screen Background To Black
Set Current Screen Background To Blue
Set Current Screen Background To Green
Set Current Screen Background To Cyan
Set Current Screen Background To Red
Set Current Screen Background To Magenta
Set Current Screen Background To Yellow
Set Current Screen Background To White
```

When you're displaying text over internal video (a solid background), you can choose from one of eight background colors. When you first set the OSD to internal mode (either with the Start Video Screen System, Start Internal Video Mode, or the Set OSD To Internal Video Background command), the background will be set to its default color. This command allows you to change the current color at any time. All screens you display after this will also be set to this color. However, if you stop then restart the video system, the screen will return to its default color (this command does not change the color).

```
Set Character Background Style To "None"
Set Character Background Style To "Outline"
Set Character Background Style To "Square"
Set Character Background Style To "Solid"
```

These commands change how the area around each displayed character appears. This applies to all text on the screen as a group. You cannot set the background for individual characters. The options are as follows:

- When the "None" mode is selected, the space around the characters will display the underlying video. This is the default mode of operation and works best when displaying internal video.

- The "Outline" mode draws a single-pixel wide black border around the text. This is useful when overlaying text onto incoming video, as it makes the characters stand out better against the video background. It is not particularly helpful in the internal video mode.

- The "Square" mode displays each character on a black square. This is useful when overlaying text onto incoming video, as it makes the characters stand out better against the video background. When used in the internal video mode, the effect is usually not desirable.

- The "Solid" mode is similar to the "Square" mode in the appearance of the text. However, this mode also displays a black border around the entire screen outside the text display area.

The effects of these different modes can be best understood by experimenting with the video control screen provided in the PC software. Display one of the built-in screens using the different background settings to see how they work.

```
Set Row Character Size To 1
Set Row Character Size To 2
Set Row Character Size To 3
Set Row Character Size To 4
```

Each row on the screen can be set to 1 of 4 sizes. The default size is 1, which gives the smallest character size. Sizes 2 through 4 increase the character size by the corresponding ratio in both height and width. As you increase the size, less characters will fit on a row, and less rows will fit on the screen.

```
Set Character Blink Ratio To 1:3
Set Character Blink Ratio To 1:1
Set Character Blink Ratio To 3:1
Set Character Blink Off
```

Individual characters on the screen can be made to blink with the Set Character Blink On and Set Character Blink Off commands discussed later. All characters which have been set to blink will then blink in unison at the rate of approximately once per second.

These commands set the ratio of the blinking on-time to the off-time. For example, the 1:3 ratio will cause the blinking text to be turned off for 3 times as long as it's on. In this case, it will be on for 1/4 of a second and off for 3/4 of a second. The table below summarizes the three available ratios.

RATIO	ON-TIME	OFF-TIME	TOTAL TIME
1:3	1/4 sec	3/4 sec	1 sec
1:1	1/2 sec	1/2 sec	1 sec
3:1	3/4 sec	1/4 sec	1 sec

The command Set Screen Blink Off stops all blinking. Any characters which have been defined to blink (by the Set Character Blink On command) will remain on continuously.

```
Set Character Blink On
Set Character Blink Off
```

Individual characters on the screen can be made to blink. This is done by setting the character blink on, then writing the text you want to blink. For text you don't want to blink, set the character blink off before writing it. The default position of the character blink is off, so if you write text without performing one of these commands first, it will not blink.

The On Screen Display works by blinking all text written while the character blink is on. Text written while it's off will not blink. For example, the following sequence of commands will cause the word "armed" to blink, but not the other text:

```
Write Text "Alarm " To Screen
Set Character Blink On
Write Text "armed " To Screen
Set Character Blink Off
Write Text "and ready" To Screen
```

Video Text Commands

These commands control the text that will be displayed on the screen. They are most often used to create custom video screens.

```
Set Cursor Row To ##
Set Cursor Column To ##
```

These two commands set the location on the screen where the next character will begin writing (called the cursor location). The row number can range from 1 to 12, and the column number can be from 1 to 24.

As you write text to the screen, the cursor location (i.e., the current row and column numbers) changes accordingly. When text reaches the end of a line, it automatically wraps around to the start of the next row. When it reaches the end of the screen (bottom right), it wraps around to the start (upper left).

```
Do Line Feed and Carriage Return
```

This command moves the cursor to the start of the next row. For example, if the current row is 11, it will change to 12. If it's 12, it will wrap around to 1. The column number will always be set to 1. This command can be used in place of separate commands to set the row and column when you want to go to column 1.

There is one quirk to how this command functions. If text has wrapped around at the end of a row and into the next row, this command will not work properly. The On Screen Display (OSD) control circuitry which generates the video text does not have a command to go to the start of the next row. Rather, it only supports commands to directly set the row and column (with the Set Cursor Row To ## and Set Cursor Column To ## commands). In order to provide this Do Line Feed and Carriage Return command, the controller maintains an internal variable which keeps track of the current row number. When it executes a Do Line Feed and

Carriage Return command, it looks at the current row number variable and sets the OSD circuitry directly to the next row number (using the Set Cursor Row To ## command) and the first column (using the Set Cursor Column To 1 command).

The problem occurs when you write text that reaches the end of a row. The On Screen Display (OSD) circuitry automatically moves to the start of the next row to display more text. However, the internal variable which keeps track of the current row number does not know the OSD circuitry has wrapped around. If you issue a Do Line Feed and Carriage Return command, it may not go where you expect it. You can always avoid this problem by directly setting the desired row and column with the Set Cursor Row To ## and Set Cursor Column To ## commands.

The advantage of the Do Line Feed and Carriage Return command is that it takes less storage space and is faster than using the two separate commands Set Cursor Row To ## and Set Cursor Column To ##. When you're creating a screen and you know your text doesn't reach the end of the row, the Do Line Feed and Carriage Return command may be most appropriate.

Clear Screen

Removes all characters from the screen and sets the cursor to upper left corner (row 1, column 1). This command only works for screens that you create. When displaying the built-in video menu system, the controller redraws the screen many times each second. If you were to execute the Clear Screen command, the screen would be cleared, then immediately redrawn.

Display Character Number ## On Screen

This command is used over the serial interface to display characters on the screen. Each command sends a single character. ## are the two hex digits representing the ASCII value of the desired character. For example:

## Value	Character Displayed
30	0
31	1
39	9
3A	:
41	A
5A	Z
61	a
7A	z

The ASCII values for the numbers and letters can be found in the appendix. However, many characters can be displayed that do not have a similar ASCII equivalent. The table below shows the ASCII values for these characters.

Note that if the cursor reaches the end of a row, it moves to the start of the next row and continues. If it reaches the end of the screen (row 12, column 24), it moves to the upper left corner.

VIDEO CHARACTERS AND THEIR ASCII VALUES

DISPLAYED CHARACTER	ASCII VALUE	DESCRIPTION
.	2E	Period
,	2C	Comma
:	3A	Colon
;	3B	Semicolon
?	3F	Question Mark
-	2D	Dash
/	2F	Slash
See note	20	Blank Space
<	3C	Left Angled Bracket
>	3E	Right Angled Bracket
See note	60	Snowman
See note	21	Left Arrow
See note	40	Up Arrow
See note	23	Right Arrow
See note	24	Down Arrow
See note	25	Small Solid Square
See note	7C	Large Solid Square
.	5E	Point (like a period, but shifted up and left slightly)
x	2A	Multiply Sign (same as small letter x, but shifted up slightly)
See note	26	Telephone
See note	28	Man
See note	29	Woman
See note	5B	Reverse Symbol
See note	5D	Forward Symbol
See note	5C	Sun
See note	22	Your guess is as good as ours!
See note	3D	Umbrella
See note	27	Musical Note
See note	5F	No Display

NOTE: These characters could not be drawn in this table. You'll have to display then and see for yourself what they look like.

```
Display 14 Characters "XXXXXXXXXXXXXX" On Screen
```

This command is used over the serial interface to write 14 characters at a time to the screen. You must write 14 characters each time; you cannot write less. This command is much faster than the previous command if you have a lot of characters to write. We recommend you use this to write as many characters as you can (in increments of 14), then use the previous command for the remaining characters.

```
Display Text String ### On Screen
```

This command writes string number ### to the screen.   The controller contains a variety of built-in strings that you can refer to by number. The following table shows the available strings.

STRING #	DISPLAYED TEXT	STRING #	DISPLAYED TEXT
0	__ENTER_MENU_NUMBER_	51	Dining_Room
1	PRESS_ANY_KEY_TO_RETURN	52	Bathroom
2	_PRESS_ENTER_TO_CONFIRM	53	Patio
3	Time:_	54	Sliding_Door
4	Date:_	55	Front_Door
5	Off	56	Side_Door
6	On_	57	Back_Door
7	Low_	58	Patio_Door
8	High	59	French_Door
9	Opened	60	Door
10	Closed	61	Interior
11	Disabled	62	Exterior
12	Enabled_	63	Perimeter
13	Set__	64	Happy_Birthday
14	Clear	65	HAPPY_BIRTHDAY
15	Neutr	66	Merry_Christmas
16	Jan	67	MERRY_CHRISTMAS
17	Feb	68	Happy_Holidays
18	Mar	69	HAPPY_HOLIDAYS
19	Apr	70	Happy_New Year
20	May	71	HAPPY_NEW YEAR
21	Jun	72	Good_Night
22	Jul	73	Good_Morning
23	Aug	74	Home_
24	Sep	75	Away_
25	Oct	76	Sleep
26	Nov	77	Party
27	Dec	78	Security
28	Monday___	79	Vacation
29	Tuesday__	80	Television
30	Wednesday	81	Stereo
31	Thursday_	82	CD_Player
32	Friday___	83	Receiver
33	Saturday_	84	Tape_Deck
34	Sunday___	85	Satellite_Receiver
35	Minutes	86	Equalizer
36	Hours	87	VCR
37	Sunrise:	88	VCR_#1
38	Sunset:_	89	VCR_#2
39	Alarm	90	DAT_Player
40	Fire	91	X-10_____
41	Bedroom	92	Flag_____
42	Master_Bedroom	93	Variable____
43	Bedroom_1	94	Timer_____
44	Bedroom_2	95	Input_____
45	Bedroom_3	96	Output_____
46	Bedroom_4	97	Sch_Event___
47	Guest_Bedroom	98	Per_Event___
48	Kitchen	99	IR_Signal___
49	Living_Room	100	Macro_____
50	Family_Room		

NOTE: The underscore character (_) is used to denote a blank space.

Video Level Adjustment

The controller's video output is an analog video signal. The exact voltage output level determines how well the video is displayed on your TV. Two key voltages are factory-set to work well with most video equipment. However, under occasional circumstances, they may require slight adjustment. Two variable resistors are provided so you can adjust these if necessary.

Video Voltage Level 1

Variable resistor RV1 on the controller circuit board adjusts the video sync level. The sync level affects display quality in both the internal and external video modes. If the video output looks similar to a scrambled TV channel or the text characters are blurry, you should adjust RV1 as follows:

1) You'll need a way to make the controller display a video screen in order to adjust the level properly. You can do this from the video control screen.

2) Disconnect all cables from the controller.

3) Remove the two screws holding the rear panel to the enclosure (they are located at the outside edges). Remove the rear panel.

4) Slide the top half of the enclosure off the rear and set aside.

5) Reconnect the video and power cables to the controller. The serial cable will also have to be connected if you need to send a command from the PC to display a video screen.

6) Display a video screen and view on your TV.

7) Adjust the video signal level by turning the variable resistor RV1 located on the circuit board. The resistor is located on the corner of the board closest to the video connectors. It is labeled RV1 on the circuit board. Use a small Phillips screwdriver to make the adjustment.

   • Normally, the resistor should be turned almost fully counter-clockwise.

   • Turning the resistor counter-clockwise increases the video signal level. Turning it too far counter-clockwise will usually blur the characters slightly.

   • Turning the resistor clockwise decreases the video signal level. Turning it too far clockwise will result in a scrambled picture as the sync level will be lost. This looks similar to a scrambled TV channel where portions of the picture run across the screen at sharp angles.

   WARNING: The resistor can only turn a certain amount in either direction. Do not force the resistor past this point or it may be damaged.

Video Voltage Level 2

Variable resistor RV2 on the controller circuit board adjusts the black video level in the external mode. It will have an effect only in the following situation:

1) displaying text overlayed onto external video, and

2) the text background is set to "Outline", "Square", or "Solid".

Under these conditions, an incorrect setting can cause the text to appear jagged, with horizontal lines, or with a completely distorted picture. If this problem exists, you should adjust RV2 in a similar manner as described for RV1.

Notes On Using The Video System

This section provides some pointers for using the video system. Also refer to the files provided on the installation disks for more information.

- When the controller is displaying the built-in video screens, it redraws most of the screen on a regular basis (every 10 milliseconds). If you're displaying such a screen and then write text on it, it will probably only appear for a split second. After displaying it, the built-in screen will be redrawn, erasing anything you wrote (there are some areas on these screens that are not redrawn, where you could conceivably write text without it being overwritten). Therefore, you should not try to add your own text to the built-in screens.

- To display your own screen, first display video screen #0. This is a blank screen that is not periodically updated. Therefore, anything you write will remain displayed until you overwrite it or clear the screen.

- If you want to display static text on your own screens, you only need to write it to the screen once. However, if you want the screen to update things as they change, you'll have to repeatedly redraw the screen with the most recent data.

CHAPTER 7: INFRARED CONTROL

Introduction

The controller provides the following infrared (IR) signal control features and capabilities:

- Can "learn" infrared commands and transmit them to control external equipment such as television, stereos, etc.

  - Can transmit directly from an IR Light Emitting Diode (LED) mounted in the front of the unit. The range is 1-35 feet depending on the angle between the controller and receiver and the receiver's sensitivity.

  - Can also simultaneously drive an external transmitter through a 3.5mm jack on the back of the unit. This connection is designed to be compatible with the Video Link series of IR transmitters (such as the Blast-IR), but should operate with other transmitters as well.

- Can receive and recognize many IR signals which can be used as command inputs or video screen system controls. The IR receiver is built into the front of the controller. Range depends on the strength of the transmitter, but has been tested at over 80 feet.

- IR signals can be viewed, transmitted, enabled, and disabled from the video screen system or serial interface.

- Can be controlled from any preprogrammed or learning remote. You do not need a special or expensive remote.

This chapter explains:

- The infrared signal formats and how the controller works with each type.

- How to program your remote so it can be used to provide inputs to the controller.

- How to teach the controller the infrared signals used by your TV, stereo, etc., so it can send commands to them.

- IR signal commands.

Infrared Signal Description

Infrared signals from remote control devices consist of a series of pulses of infrared light. Each button on each remote uses a different combination of pulses. Different devices from different manufacturers often use different pulse formats. The many different formats make it a challenge to design a device that can receive and transmit all types.

In spite of this complexity, the controller is compatible with the vast majority of commercial remote control devices used today. However, there are a few limitations. The IR capabilities are as follows:

- Works with modulated and unmodulated infrared signals (does not work with ultrasonic or RF remotes).

- Works with carrier frequencies in the range of 10kHz to 70kHz. Most consumer electronics use remotes near 40kHz. Near the 10kHz and 70kHz limits, the receiver sensitivity drops off slightly.

As noted above, there are a wide variety of infrared signal formats. However, as far as the controller is concerned, they can be separated into two types:

1) "standard" format signals, and

2) all others.

These two types of signals are handled differently when being received or transmitted by the controller, as discussed below.

Standard Infrared Signals

Description

The "standard" format is used by many infrared remotes on the market today. If you have a programmable universal remote, you can choose from a variety of codes (devices) that use this standard format. Remotes using this format will be the easiest to use for sending commands to the controller.

Standard format infrared signals are described by two parameters: "Device Code" and "Key Code". Each button (or key) on a remote has a different Key Code, but all have the same Device Code. Device Codes vary between different electronic equipment, although there are some devices which happen use the same codes. Key Codes are not necessarily the same from remote to remote. For example, the Volume Up button may have one Key Code on a Sony remote, but a different code for a Pioneer remote. This does not pose any problems for the controller.

Receiving Standard Format Signals

The controller is designed to automatically recognize received signals which use the standard format. The signals can be used in two ways:

- To navigate through the video screen system.

- To send a message over the serial interface that the signal was received. The PC software can then take specific actions on it.

Transmitting Standard Format Signals

You can transmit IR signals to devices such as televisions and stereos which use the standard format. Before doing this, the controller must know the exact signal format. There are two ways to do define it:

1) Enter the signal's Device Code and Key Code. The PC software provides a simple way for you to determine what these codes are and then enter them.

2) "Learn" the signal. "Learning" is the process by which the controller analyzes the signal and stores it in memory. The signals are stored as measurements of the pulse lengths. This takes more memory than simply storing the signal's Device Code and Key Code. Learning signals in this way is not necessary for standard format signals. However, it is the only way to handle signals which do not meet the standard format, as discussed in the following section.

Other Infrared Signals

Description

Any signal not following the standard format falls into this category. The controller must "learn" these signals by measuring and storing the individual lengths of the infrared pulses.

Receiving Other Format Signals

Signals in non-standard formats can be received by the controller and "learned" for later transmission. However, during normal operation, the controller cannot recognize when such a signal is received. Thus, these signals cannot be used as commands to the controller or for controlling the video screen system. Only standard format signals can be used for this purpose.

Transmitting Other Format Signals

Before the controller can transmit these non-standard IR signals, it must "learn" the signal's format. The signal format is then stored in the controller's memory ready to be transmitted upon command. The process for learning is described later.

The controller learns signals by measuring and storing the individual lengths of the infrared pulses. The number of pulses varies from device to device. Consequently, the amount of memory required to store each pulse varies. Most signals require 60 to 200 bytes of memory. The controller has approximately 45,000 bytes of memory available for the IR signals. This should be more than enough to hold 255 signals.

IR Signal Reception Details

Introduction

This section covers receiving signals from a remote control device to control the operation of the controller. The process of learning an IR signal for re-transmission is covered in the later section on transmission.

Receiving and recognizing IR signals (which we call "decoding" the signal) is far more difficult than learning a signal for re-transmission. Most electronic devices only have to work with one remote control type. Designing a "universal" receiver to work with many different signal formats is quite a challenge.   Every received signal must be analyzed to determine if it matches one of the many millions of possible signals. The decoding must take place in near real time to provide an acceptable user interface to the automation system. Factor in "noise" caused by the infrared light present in most ambient lighting and the task becomes even more difficult. This is why very few home automation systems today provide this capability.

The controller design overcomes these problems and is compatible with many different remote control types (those following the "standard" format). However, there are some signal types which it cannot automatically recognize. Fortunately, all learning remotes or preprogrammed universal remotes can be configured to be compatible with the controller. The wide range of signals compatible with the controller should make it relatively easy to find appropriate signals for you to use.

Using IR signals as command inputs gives your home automation system a very quick response time. Most IR signals are under 200mS in duration. Since the controller can begin executing commands in less than 1mS, the controller will respond nearly instantly to your command. Response time is much faster than with an X-10 type remote control system. In the X-10 system, IR signals are first transmitted to a special receiver unit. The receiver then transmits an X-10 signal which can be received by the controller and used to command actions. The relatively long length of an X-10 signal (about 1 second) makes the entire process much slower.

Controller Setup For Receiving IR

Setting Up The Remote Control Video Screen System

The built-in video screen system allows you to control your home automation system using a TV and a hand-held remote control. The video screen system is described in detail in the video chapter. Before you can use this, you have to set up your remote and the controller. This section describes how to do this.

Configuring A Preprogrammed Remote

The easiest way to send IR signals to the controller is with a "preprogrammed" remote. A wide variety of such remotes are available today. Some control as little as one device, while others control up to a dozen. Some are available for less than $10.

To use this type of remote, you enter a code number for the type and brand of equipment you want to control. Most remotes can handle several types of equipment (TVs, VCRs, cable boxes, stereos, etc.). You access each type by pressing the corresponding button on the remote (or perhaps sliding a switch). When using these remotes with the controller, you have complete freedom as to what functions you assign to each button.

Follow this process to set up a programmable remote:

1) Choose a remote control device. Here are some suggestions:

   • Select a remote that has at least the following buttons (keys):

      - The number keys 0 to 9
      - Channel up and down
      - Volume up and down
      - Two other keys (ideally, they would be labeled "Enter" and "Clear" or "Cancel")

   These 16 keys are used to control the video screen system. They don't have to match these exactly, as you can assign the functions to any keys. However, remotes with these buttons will make it easier for you to remember which button does what.

- If you want to use one remote to control both your TV and HomeVision-PC, choose a remote that can control <u>two</u> different TVs. Use one of these for your TV, the other as the input to the controller.

- If possible, use the TV function to control HomeVision-PC. An auxiliary function is also OK if you can set it to the TV codes. Since the video screen system requires the channel and volume keys, it works best when set to the TV device. This is because of the way most remotes handle the other devices like VCRs and cable boxes. When you select one of these devices on the remote, the volume keys are normally not affected. Instead, they continue to control the TV volume, even though the other buttons now control the VCR or cable box.   Therefore, you cannot reassign these keys to a different code for the controller (as they'll still be controlling your TV).

2) Select a device code

- Preprogrammed remotes come with a listing of all the devices they support and the codes for each. You'll need to select from these a code that the controller can recognize. The controller can recognize a wide variety of codes under the TV, VCR, Cable Box, and Auxiliary functions. You only need to select one of these. As noted above, the TV function is recommended.

- Table 7-1 lists some of the many codes the controller can receive. Codes are given for the most common remote control brands. If you don't have one of these brands, you may have to do a little experimenting. Try using your remote's codes for the brands of equipment shown in the table.   You can then test it as described in "Testing A Preprogrammed Remote" to make sure it generates the correct infrared signals.

- Once you've chosen the remote code to use, program it into your remote following the instructions that came with it.

- We suggest you select an equipment brand different than any equipment you own. You don't want your VCR changing channels every time you use your remote to send a command to the controller!

3) After setting up your remote, it's a good idea to test it to make sure it doesn't affect any of your equipment. If it does, you should select a different code for your remote.

Device Type	Device Brands	Codes				
		One For All, Control 1, Emerson	Magna-vox	Gemini	RCA	Sony
TV	Hitachi	145	0030	100	047	31
TV	Hitachi	227	NA	320	063	NA
TV	Sharp, Realistic, Montgomery Ward, Optonica	165	0040	070	025	15
TV	NEC, Techwood, Citizen, Candle, Hitachi, Luxman, TMK, Samsung	056	NA	310	027	03 or 12
TV	Candle, Citizen, Magnavox, Philco, Sylvania, Teknika	186	0048	080	66	NA

VCR	Goldstar, Pilot, LXI, Marta, Sears, Realistic, Emerson, Totevision, Memorex	037	1008	022	009	32
VCR	Yamaha, Goldstar, Marantz, Vector Research, NEC	038	1009	292	014	37
VCR	JC Penny, Pentax, Hitachi, Sears, RCA, Montgomery Ward	042	1011	032	005 or 035	05

Table 7-1   Some Preprogrammed Remote Codes Compatible With The Controller

Testing A Preprogrammed Remote

This process verifies that the remote is set up to transmit standard format IR signals which the controller can recognize.

1) The controller must be connected to the PC serial port

2) Select "IR Test" from the "Other" menu. The IR test screen will appear.

3) Aim your remote at the controller and transmit the signal. The remote does not have to be close to the controller for this. It should work up to 30 feet or more depending on the remote's strength.

4) If any infrared signal is received, regardless of its format, the "IR RX" LED on the controller's front panel will blink. In addition, the green "LED" on the computer's IR test screen will also blink.

5) If the received infrared signal follows the standard format, the signal's Device Code and Key Code will be displayed. If question marks are displayed in the Device and Key Code fields, then the signal doesn't follow the standard format.

Configuring The Controller To Control The Video Screen System

Once you've programmed your remote, you need to set up the controller to recognize the remote's signals. The controller is initially set up to respond to a specific type of remote control device. If you program your remote to match this, you do not need to configure the controller. The initial (default) remote device is the device listed in the first row of Table 7-1.

To set up the controller to use a different remote control, proceed as follows:

1) Select the video remote control configuration screen from the "Configuration" menu. A configuration screen will appear. This screen shows the 16 keys that are used in the video screen system. Each key has its own Key Code and a label, both of which you can edit. There is also a "Device Code" and label. The codes and labels will be filled in with the controller's current settings (the first time you use it, it will contain the "default" remote settings).

This screen displays three sets of 16 remote Key Codes, each accessed through a set of "tabs". You'll probably never need to use more than one of these three sets; the others allow two additional, different remotes to control the video screen system.

2) If you programmed your remote to any code other than the default one, click on the "Select Remote" button. A dialog box will appear. Select your chosen remote from the list in the dialog box and click the "OK" button. This will return you to the previous screen. If your remote doesn't appear in this list, skip this step.

3) The Device and Key Codes for the selected remote will be filled in, along with the labels. The Device and Key Codes must be sent to the controller so it knows what remote you're using. The labels are for your own use. Some remotes use different labels, and your keys may differ slightly from what those listed. For example, many remotes don't have a "Cancel" key. Its function may instead be under "Clear" or "Recall". You can use the label field to identify which buttons on your own remote are used for which functions.

4) To test the 16 video screen control buttons, push each of the corresponding buttons on your remote (one at a time!). The Device Code and Key Code for the received signal will be shown in the window. Compare these to the codes listed beside each of the 16 functions. If all 16 buttons match, you're ready to control the video screens. If some of the buttons use different Key Codes, you can change the entry to match the actual received Key Code. Some points to note:

   • If your remote is transmitting different Device and Key Codes than those shown, it's not a problem. Just enter the actual Key Codes in the text boxes corresponding to each function, and the Device code in the Device Code text box.

   • All signals from a specific remote should have the same Device Code. This code should match the one shown in the Device Code text box.

   • Most remotes don't have a "Cancel" button; we've initially assigned this function to the "Mute" button. You may want to move this to a different button that works better with your remote's keypad layout.

5) Load the remote settings to the controller. Until you do this, you won't be able to use the remote to control the video screen system. To do this, choose "Load Schedule" from the "File" menu. Click the "Load" button to load the schedule.

Once all 16 buttons are working, you can use the remote to navigate through the video screen system, as described in the video chapter.

Assigning Video Functions to Different Keys

Any of the 16 keys used by the video screen system can be assigned to any key on your remote. All 16 keys must have the same Device Code, but each will have a different Key Code. To assign a function to a different key:

1) Identify the signal's Device and Key Codes. You can use the method described in "Testing A Preprogrammed Remote" to find these.

2) Verify that the signal's Device Code matches that shown in the video remote control configuration screen. All signals from a specific remote should have the same Device Code.

3) Enter the signal's Key Code into the Key Code field of the function you want to replace. For example, if the received signal's Key Code is 145 and you want to use it for the "Cancel" function, enter 145 in the Key Code field for the "Cancel" button.

Configuring A Learning Remote

Learning remotes require you to transmit an infrared signal to the remote, which then "learns" the signal. When programming a learning remote, you must teach it signals that follow the standard format. This will allow those signals to be received by the controller. The process is as follows:

1) In the PC software, select "Infrared Test" from the "Other" menu.

2) Connect the controller to the serial port and make sure the infrared receive function is enabled. Also make sure the video screen system is off.

3) Select a Device Code to use. You can pick any number from 0 to 255.

4) For each of the buttons you want to program, choose a different Key Code. Key Codes can range from 0 to 255.

5) Teach the signal to your remote by transmitting it from the controller to your learning remote. If your remote needs only a single key press, click the "Transmit Once" button on the screen. If your remote requires repeated transmissions, click the "Xmit Repeatedly" button. When your remote has learned the signal, stop the transmissions by clicking the "Stop" button or pressing any key on the keyboard.

6) Test your remote as described in "Testing A Preprogrammed Remote" to verify that it learned the signal properly.

7) After your remote has learned all the signals, you must configure the controller to recognize them. Follow the same process as for the preprogrammed remotes (i.e., enter the Device Codes and Key Codes on the video remote control configuration screen under the "Configuration" menu).

Setting Up A Remote To Use As Command Inputs

In addition to controlling the video screen system, your remote can be used to issue commands to the controller. Whenever these signals are received, the controller will transmit a message over the serial interface. Software on the computer can then take action on it.

The procedure for setting this up is:

1) Configure your remote to transmit standard format signals. Refer to the section "Configuring A Preprogrammed Remote" to do this. You might want to use unused functions on your remote as command inputs. For example, if your remote has a cable box function that you're not using, its keys could be configured as command inputs.

2) Verify your remote is properly transmitting standard format signals. Refer to the section "Testing A Preprogrammed Remote" to do this.

3) Record the Device and Key Codes for each signal.

4) Load the new schedule into the controller.

IR Signal Transmission Details

Electrical Connections

The controller can transmit IR signals to devices such as televisions and stereos. An infrared transmitter is built into the unit and transmits from the front panel. In addition, the controller can simultaneously drive an external transmitter through the 3.5mm jack on the rear panel. Each method is discussed below.

Transmitting From The Controller Front Panel

An infrared diode is mounted on the controller circuit board and aims out the front of the unit. The diode is located on the left side of the unit (to the left of the "ON" LED) when viewed from the front. It has an effective range of 15-35 feet depending on the angle between the controller and the receiver, and the receiver's sensitivity.

This diode can be disabled by removing jumper JP on the circuit board. The following figure shows the location of the jumper and the diode.

IR Transmitting
Diode

Jumper

JP

EPROM

TB1 Port A

TB2 Port B

TB3 Port C

RV1

RV2
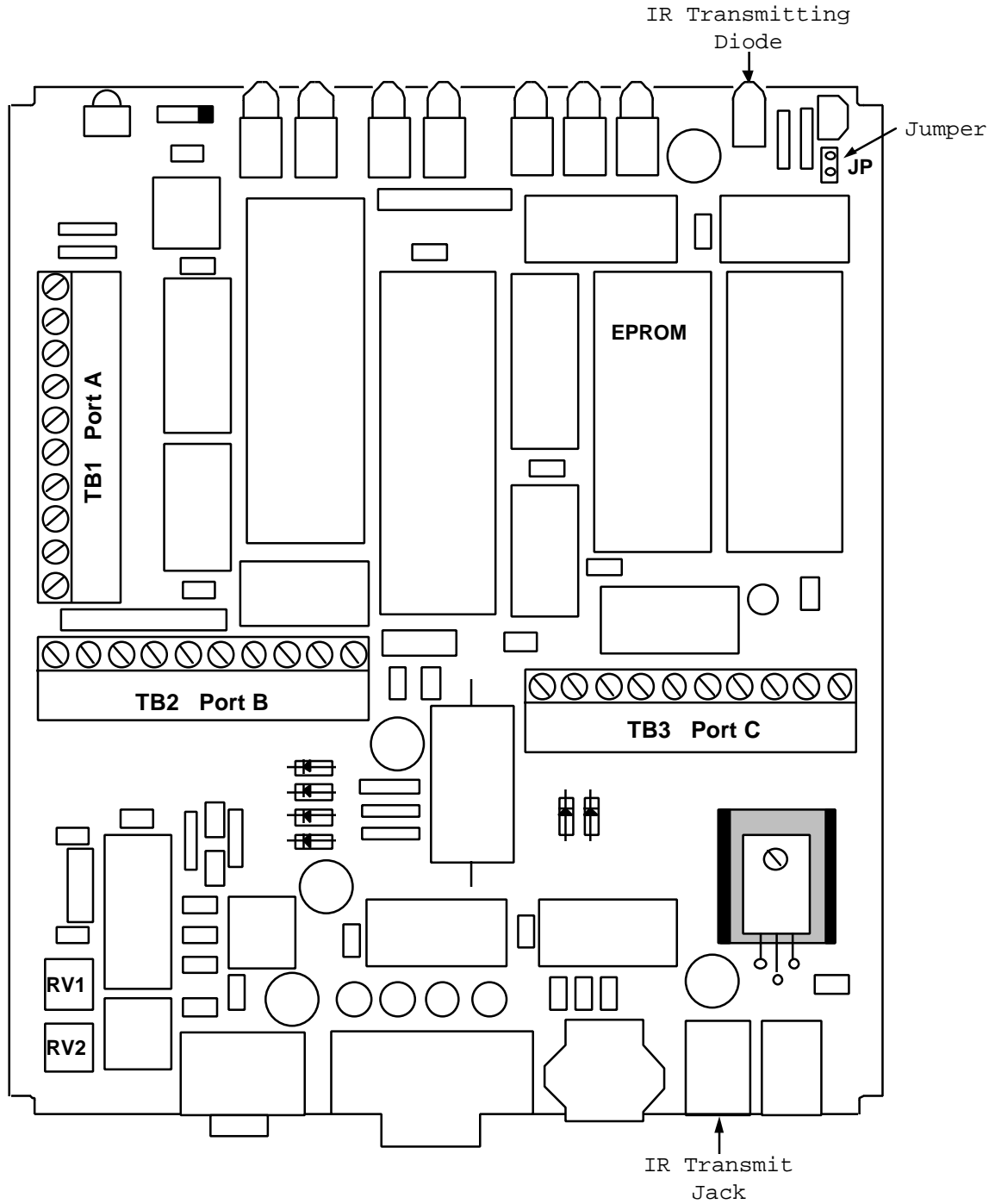
IR Transmit
Jack

Transmitting From The Controller Rear Panel

A 3.5mm jack is provided to drive an external infrared transmitter if desired. The jack is located on the controller's rear panel and is labeled "IR TX". You can transmit through this output and the front panel diode simultaneously if desired. This jack is always active, even when the jumper JP is removed.

This output has the following electrical characteristics:

- When off (not transmitting):

    - If jumper JP is in place, the output is tied to ground through a resistor and the IR LED. If jumper JP is removed, the output is open.

- When on (transmitting):

    - Output is 5V nominal with no current limiting resistor. If jumper JP is in place, then the rear panel output can provide up to 100mA current. If jumper JP is removed, then the rear panel output can provide up to 200mA current.

- A schematic of this circuit is shown below:
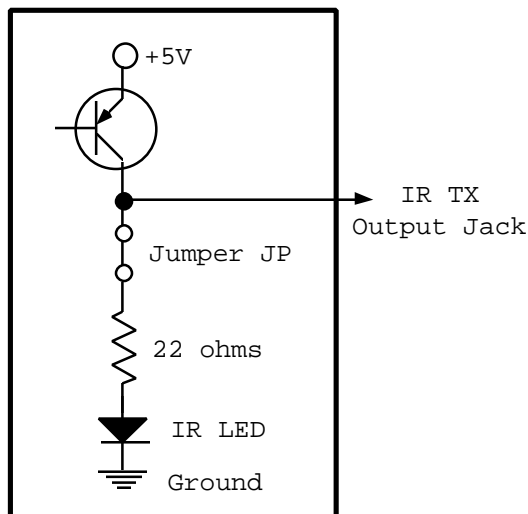
> **WARNING: This output is driven by 5 volts through a transistor with no current limiting resistor. External devices must limit the current draw to the levels noted above. This can be done with a current limiting resistor, an AC-coupled circuit, or other methods. Do not connect a diode directly across the output to ground, as there would be no current limiting. Doing so will short circuit the controller's 5V output, shutting it down. If this happens, remove the 3.5mm (IR TX jack) connection. Normal operation should resume.**

This output can directly drive Xantech Corporation's Video Link Blast-IR transmitter. This device draws approximately 50mA.

Configuration For Transmission

Before the controller can transmit an infrared signal, you must tell it what the signal looks like. This can be done in two ways:

1) You can use the "IR Learn" screen to record the pulse lengths of the signal.

2) If the signal follows the "standard" format, you can enter the signal's Device Code and Key Code.

Each method is explained below.

Learning Infrared Signals For Transmission

"Learning" is the process by which the controller analyzes the IR signal and stores it in memory. The procedure is as follows:

1) The controller must be connected to the PC serial port.

2) Select "IR Learn" from the "Other" menu. The IR learn screen will appear.

3) To learn a particular signal, click the "Learn" button. The PC will display the message "Preparing controller ..." and attempt to put the controller into the learn mode. If the controller does not respond, the PC will abort the learning process and display a message. If this happens, verify that the controller is properly connected and communicating. If successful, the message "Aim remote at controller and transmit once" will be displayed. Then:

- Hold the remote approximately 4 inches away from the front panel and point it toward the "IR Receive" window. Remotes with different strengths may need to be held at slightly different distances; 4 inches is a good starting point. If it's too far, away slowly move it closer.

- Press and release the remote button you're learning. The idea is to transmit a single signal. If you press down too long, the remote may transmit multiple signals.

- Depending on the remote and how close you hold it to the controller, one of five things will happen. Wait several seconds to see what happens; don't immediately press the button again. The possibilities are:

    A) The message "IR signal received, now analyzing ..." is displayed. This is followed by the message "Done analyzing signal". This indicates the signal has been successfully learned. Four key signal parameters will also be displayed in the upper right corner of the screen:

    - **Carrier frequency**. This is the actual carrier frequency of the signal. The controller works with carrier frequencies in the range of 10kHz to 70kHz. Most consumer electronics work near 40kHz.

    - **Number of pulses**. This is the number of pulses in the signal.

    - **Signal length**. This is the length of the signal in milliseconds. Typical signals are from 40ms to 200ms.

    - **Duty cycle**. This is the percent of time that the carrier frequency is modulated on for. It's usually around 40%.

    Note that there are more details that aren't shown. Signals which have all the same parameters shown above aren't necessarily the same.

B) The message "Remote may be too close to controller" is displayed. If this happens, you need to move the remote a couple inches further away and try again. The learn mode is automatically restarted and the controller waits for you to transmit again.

C) The message "Remote may be too far away from controller" is displayed.   If this happens, you need to move the remote a little closer and try again. The learn mode is automatically restarted and the controller waits for you to transmit again.

> NOTE: There are times when the controller cannot accurately determine whether the remote is too close or too far away. If you follow the messages to move the remote closer or further away and still can't get it to learn, try moving it to a different distance. Some remotes need to be as close as 1 inch and others as far away as 3 feet in order to properly learn.

D) An error message is reported. This means there was a problem with the format of the signal. Try again. If the problem persists:

   - Move the remote closer to or further from the controller.
   - Press the remote button very quickly; don't hold it.
   - Record the error message and report it to us. This may be an unusual signal which the controller cannot learn.

E) Nothing happens. This indicates the controller did not receive any IR signal at all or that it is not properly set up to report it. Try again. If there's still no response:

   - Verify the controller is set up as described in Step 1.
   - Make sure the remote's batteries are OK.

> NOTE: If you still can't get this to work, uncheck the "Learn carrier frequency" box and try learning again. You should then be able to hold the remote at any distance. However, the controller won't attempt to measure the carrier frequency. Instead, it will default to 38.4kHz, which works for most remotes. You can manually change the frequency in the text box if necessary to make it work. Refer to the help file for more details.

4) After the signal is successfully learned, it should be tested. Click the "Load" button. This loads the signal into a special test area in the controller's memory.

5) Click the "Xmit Test" button, and the controller will transmit the signal which was loaded into its test memory. Aim the controller (or an external IR transmitter, if connected) at the device you want to control. It should respond to the IR signal. If it doesn't, try learning the signal again.

6) After you've verified the signal was learned properly, you must save it to one of the defined IR signals. Select a signal from the list box under "IR Signal To Save To". Click "Save". If you don't have an IR signal defined to save it to, you can go to the IR signal summary screen under the "Objects" menu and define it, then return to the IR learn screen and save it.

7) Repeat this process for each signal you want to learn.

8) Save your schedule file (which holds the IR signal format data).

9) Load the schedule into the controller.

Here are some tips for learning remote signals:

- Aim the remote directly at the "IR Receive" window on the front panel. Holding it at a wide angle will occasionally prevent learning a signal. Note that this alignment is only needed when learning. Normal reception works at much wider angles and longer distances.

- If you have problems learning, put fresh batteries in your remote. Weak signals make it more difficult to learn accurately.

- If the learned signal does not properly control your equipment, try learning several times. Compare the carrier frequency, number of pulses, and signal length for each:

  - If the carrier frequency is near 10kHz or 70kHz, the signal is near the controller's limits and may be more difficult to learn. You may have to try several times.

  - The carrier frequency should be fairly stable (within 2kHz each time). If it varies by more than this, try moving the remote a little closer or further away.

  - If the signals are of different lengths or have different number of pulses, you may be getting multiple transmissions when you're pressing the button. Try pressing it more quickly.

Transmitting Standard Infrared Signals

If your remote-controlled equipment happens to follow the "standard" infrared signal format, you can store its signals by referring to its Device Code and Key Codes instead of following the "learning" process (although you can learn the signals also).

1) To determine if your remote uses the standard format, follow the procedure described in "Testing A Preprogrammed Remote". If it doesn't, you will have to "learn" these signals as described earlier.

2) Record the Device and Key Codes for each signal you want to learn.

3) Open the IR signal summary screen (under the "Objects" menu).

4) Select a signal to save each signal to. Double-click on any of these three fields:

   - IR Signal Type
   - Device Code
   - Key Code

   All of these call up the IR data screen. From there:

   A) Select "Standard" from the signal format list box.

   B) Enter the signal's Device Code and Key Code which you recorded earlier in the corresponding text boxes.

   C) Click "OK" to return to the IR signal summary screen.

5) Make sure the "Transmit Enabled" checkbox is set for the signal (on the IR signal summary screen). This signal has now been set to transmit the specified standard signal and thereby control your equipment.

6) Save your schedule file (which holds the IR signal format data).

7)   Load the schedule into the controller.

IR Transmission Settings

The gap between infrared signal transmissions is variable from 0 to 255 milliseconds. The default value is 100ms and should work in almost all situations. If you find that some transmission don't work properly when you send them back-to-back, you may want to try a longer gap. The only drawback to a longer gap is that multiple transmissions take a little longer. You can try setting the gap to less than 100ms to speed things up, but be sure to test it to make sure it works consistently. How well it works depends entirely on your particular equipment. You can set the gap from the controller configuration screen under the "Configure" menu.

When you learn an infrared signal, you can adjust the duty cycle of the carrier frequency. The default setting is 40% which should work in almost all cases. However, if a learned signal doesn't control your equipment properly, try adjusting this factor. Values between 20% and 70% will often work.

If you're transmitting with external "mini" emitters placed directly on the receiving window of your equipment, you may run into occasional difficulties.   Such emitters sometimes overpower the receiver. This is usually due to driving the emitter with a high voltage source that increases the LED drive current, a problem not attributable to the controller itself. However, the controller can help to alleviate such problems by reducing the signal's duty cycle. This reduces the overall energy in the transmitted signal, sometimes allowing such over-driven emitters to work properly.

Importing and Exporting IR Signals

Learned infrared signals can be exported to and imported from a disk file. This allows you to save the signals and use them in another schedule. Importing and exporting is done from the IR signal summary screen.

Notes

- To select signals for importing or exporting:

    - Move the cursor to the left end of the row. The cursor will change to a check mark.
    - Click to select or deselect the row.

- The IR signal storage file will have an extension of "IRL".

- The following data is imported and exported:

    - Name
    - Description
    - Format (device and key codes or pulse length data)

- Actions associated with the signals are not imported or exported.

IR Signal Commands

```
Transmit IR Signal Once
```

This command will transmit the infrared signal one time.

`Transmit IR Signal ## Times`

This command will transmit the infrared signal ## times. The ## value can be between 1 and 255.

`Disable IR Signal Transmit Mode`

The transmit capability of each infrared signal can be individually enabled and disabled. When disabled, commands to transmit the signal will be ignored.

`Enable IR Signal Transmit Mode`

This command will enable transmission of the specified signal. It does not actually transmit a signal. See the discussion of the preceding command for more information.

`Disable IR Signal Receive Mode`

This command will disable receiving of the specified signal.

`Enable IR Signal Receive Mode`

This command will enable receiving of the specified signal.

CHAPTER 8: CONTROLLER FUNCTIONS

Introduction

The controller has many operating modes and functions. The following section explains the settings and commands that are available and what they do.

Event Log Commands

These commands control the event log which can be displayed on your TV.

```
Enable X-10 Receive Log Mode
```

This command enables automatic logging of received X-10 signals to the controller's event log. Whenever a signal is received, it will be written to the log, as shown in these examples:

```
X10 RX: A-1

X10 RX: A-Off

X10 RX: D-All Lights On

X10 RX: Preset Dim 30
```

```
Disable X-10 Receive Log Mode
```

This command disables automatic logging of received X-10 signals to the controller's event log.

```
Enable Input Port Log Mode
```

This command enables automatic logging of input port changes to the controller's event log. Whenever an enabled port changes, it will be written to the log, as shown in these examples:

```
Input: Port B 1
  changed to high

Input: Port B 5
  changed to low
```

```
Disable Input Port Log Mode
```

This command disables automatic logging of input port changes to the controller's event log.

Other Commands

```
Turn User LED On
Turn User LED Off
```

The "U" LED, third from the left on the controller's front panel, can be controlled by the user. These two commands turn it on and off.

Execute Self-Test

This command causes the controller to execute a self-test and transmit the result over the serial interface. This is the same self-test the controller performs automatically at power-up. The test result is contained in one byte which is transmit as two ASCII hex characters. The value should be converter to binary and each bit evaluated. The bit meanings are as follows:

            bit 0 (LSB) :   0 = Port A/B Control Test Passed
                            1 = Port A/B Control Test Failed
            bit 1 :   0 = External RAM Read/Write Test Passed
                            1 = External RAM Read/Write Test Failed
            bit 2 :   0 = Port C Test Passed
                            1 = Port C Test Failed
            bit 3 :   Not used
            bit 4 :   0 = Microcontroller Test Passed
                            1 = Microcontroller Test Failed
            bit 5 :   0 = PROM Test Passed
                            1 = PROM Test Failed
            bits 6 - 7 :   Not used

Read Error Message

This command causes the controller to transmit the error message ID # over the serial interface. Refer to the "Miscellaneous" chapter for a description of error messages.

Clear Error Message

This command causes the controller to reset the error message ID number to zero, indicating no error. The error message ID is also cleared automatically each time power is cycled. Refer to the "Miscellaneous" chapter for a description of error messages.

Halt Controller
Resume Controller

These commands halt and resume the operation of the controller. When halted, the controller will not:

- receive any X-10 or infrared signals,
- check for input port changes, or
- update the video screen (if active)

However, the controller can still receive and execute commands over the serial interface while halted. This includes commands to transmit X-10 or IR signals, change output ports, change the video screen, or any other action.

Transmit Controller Status

This command causes the controller to transmit a status message over the serial interface. The format is as follows:

- The returned value represents a number between 0 and 255. When converted to binary, the 8 bits have the following meanings:

bit 0 (LSB) :   0 = controller running
                1 = controller halted
bit 1 :   0 = no controller error
                1 = controller error
bit 2 :   0 = TW-523 is present
                1 = TW-523 is not present
bit 3 :   0 = controller running loaded schedule
                1 = controller using default schedule
bit 4 :   0 = power-up self test passed
                1 = power-up self test failed
bit 5 :   Not used
bit 6 :   0 = RAM checksum OK
                1 = RAM checksum error
bit 7 (MSB) :   Not used

```
Set Baud Rate To 1200
Set Baud Rate To 2400
Set Baud Rate To 4800
Set Baud Rate To 9600
Set Baud Rate To 19200
```

These commands change the baud rate used on the serial interface to the specified rate.

CHAPTER 9: SERIAL INTERFACE

Introduction

The serial interface provides the following features and capabilities:

- This is the communications interface between the computer and the controller. It is used to load your schedule.

- The controller can also use the serial interface to transmit messages to a computer or other device. Any event can be reported, such as:

    - Input port changed
    - X-10 signal received
    - IR signal received

The controller communicates with the computer via a standard serial interface (RS-232). The supplied cable connects the computer's 9-pin serial port (a male DB-9 connector) to the controller's 9-pin serial port (a female DB-9 connector). If your computer uses a 25-pin serial connector instead of a 9-pin connector, an adapter is required.

The PC-based computer program supplied with your controller uses the serial interface to communicate with it. You can also use this interface to send your own commands to the controller or receive information from the controller. You can use a standard communications (or terminal) program for this purpose, or you can incorporate the communications in your own program. In fact, any device that can transmit RS-232 serial data can be used to operate the controller.

You do not need to know anything about the serial interface except how to connect the cable between the controller and your computer. The rest of this chapter is a detailed description of the interface protocol for those who wish to perform their own interfacing to the controller. If you do not plan to use this capability, you may wish to skip the rest of this chapter.

This chapter is divided into two sections describing:

1) How to transmit commands to the controller.

2) How to interpret command responses and other messages from the controller.

Serial Interface Commands To The Controller

There are a large number of commands that can be transmitted to the controller over the serial interface. When received by the controller, it executes the command and reports the results back over the serial interface. The format for transmitting commands to the controller is described in the text file "Serial" located on the program disks.

Serial Transmissions From The Controller

There are two types of data that can be transmitted by the controller over its serial interface:

- **Report Messages**: The controller automatically report the occurrence of a variety of events. These include X-10 signals received, input ports changing, and IR signals received.

- **Command Responses**:   Whenever a command is sent to the controller over the serial interface, the controller will provide a response over the same interface. The response will acknowledge the command received, provide any data that's requested, and provide an indication of completion.

The general data formats for the two types of transmissions are described below.

Controller Report Messages

The controller can be set up to report different types of events when they occur, such as:

- X-10 command received
- IR signal received
- Input port changed state

Report Message Format

When the controller is configured to report events, it will transmit a new message every time the event occurs. See the file "Serial" for more details. The message follows the following format:

```
XX <Message> {CR} {LF} {Terminator}
```

- "XX" is the Message ID Number. Each type of report message from the controller has a unique ID number in a 2-digit hexadecimal format. Each digit will be a hexadecimal value (numbers 0-9 or letters A-F). When converted to decimal, they represent the numbers 0 through 255. See Table 9-1 for the Message ID Numbers of each type of report message. They range from 80h through A3h. By reading these two bytes, a user program can quickly identify the type of message from the controller.

- "<Message>" will contain a text description of the event. Typical messages are:

    IR Signal #85 Received
    Input Port #4 Changed High

- *{CR}* signifies that a carriage return is sent.

- *{LF}* signifies that a line feed is sent.

- *{Terminator}* signifies that a single-byte terminator code is sent. The byte has a value 1d, which is the ASCII code SOH. The terminator is provided to make it easier for a PC program to read and interpret the messages from the controller.

> NOTE: The carriage return and line feed do not actually appear on the screen if you're using a terminal emulation program. Rather, they cause the cursor to move to the beginning of the next line. The terminator code (ASCII code SOH) also will not appear on some terminal programs (although other programs may display it as a special symbol). The PC software's built-in terminal emulator strips this character out.

ID # (Hex)	MEANING
80	Power Restored
81	Self Test Passed
82	Self Test Failed
86	Controller Reset (due to error)
90	X-10 House and Unit Codes Received
91	X-10 House and Function Codes Received
92	X-10 Function Code Only Received
93	X-10 Transmit Failed (Collision)
98	Input Port Changed
A0	Infrared Signal Received
A1	Received Infrared Signal ID #
A2	Received Infrared Code #
A3	Unknown Infrared Signal

Table 9-1   Serial Report Message ID Numbers

Command Responses

Whenever the controller receives a valid command, it provides a response confirming it was performed or reporting an error. You will only see this message if you send a command with a terminal emulator. Details on issuing commands to the controller and the resulting responses are provided in the text file "Serial" on the program disks.

CHAPTER 10: WEATHER DATA

Introduction

The video screen system contains a weather screen. This screen can display a variety of weather data, as shown in this example:

```
  WEATHER CONDITIONS
            NOW  LO   HI
Inside Temp   72   70   74
Outside Temp  77   68   82
Inside RH     65   60   70
Outside RH    85   79  100
Wind Speed    16
Wind Direct  340 NNW
Rain Today  0.58 Inches
Pressure   30.05
PRESS ANY KEY TO RETURN
```

The weather data must be provided via the serial interface.

Weather Variables

The controller contains internal variables (called "system variables") to hold weather data. Some of these variables are used for displaying information on the weather screen. Other weather variables are not displayed, but can be used for other purposes. In future versions, we will be adding more commands to take advantage of these other weather variables.

Each weather variable is limited to the range of 0 to 255. This makes it tricky to hold negative numbers or decimals. To get around this problem, different variables have different formats. Some variables have an "offset" which must be added to or subtracted from the actual value. Other weather data requires <u>two</u> variables to hold the complete information (such as one variable to hold the rainfall inches, and another to hold the rainfall hundredths of inches).

Some of the weather variables have special values that determine how they are displayed on the weather conditions video screen. For example, a relative humidity variable with a value of 255 is displayed as blank spaces instead of a number. You can use this if you don't have a way to determine the actual relative humidity. Set it to 255, and it won't appear on the weather screen. If you didn't do this, it might display an incorrect number.

Before using these variables, you should carefully read the descriptions provided below. You will set these variables using the weather data commands, described later.

Temperature Variables

Six different temperatures can be tracked:

- Current inside temperature
- Today's low inside temperature
- Today's high inside temperature

- Current outside temperature
- Today's low outside temperature
- Today's high outside temperature

The temperatures can range from -99 to +154 degrees in 1 degree increments. Temperatures are stored as the actual temperature plus 100. When using the weather conditions video screen, the controller automatically subtracts 100, then displays the result. This allows negative numbers to be displayed. There are two exceptions to how the temperature is displayed:

1) The value of 0 is displayed as -99 degrees instead of -100. This is because the screen does not have enough space for "-100".

2) A value of 255 is displayed as blank spaces instead of a number. This is so that temperatures that aren't available can be left blank instead of displaying a meaningless number.

Here are some examples of how different variable values would be displayed:

VARIABLE VALUE	DISPLAYED VALUE
0	-99
1	-99
2	-98
99	-1
100	0
101	1
175	75
254	154
255	

Relative Humidity Variables

Six different relative humidity values can be tracked:

- Current inside relative humidity
- Today's low inside relative humidity
- Today's high inside relative humidity
- Current outside relative humidity
- Today's low outside relative humidity
- Today's high outside relative humidity

Relative humidities can range from 0 to 100 in increments of 1%. A value of 255 is displayed as blank spaces.

Barometric Pressure Variables

Both pressure and the direction of change can be stored:

- Current barometric pressure – inches
- Current barometric pressure – hundredths
- Barometric Pressure Direction

The barometric pressure requires two variables for storage, one for the inches reading, and one for the hundredths. Each variable can range from 0 to 99 in increments of 1. All other values are displayed as blank spaces.

The barometric pressure direction of change is stored as follows:

    0 = steady
    1 = falling
    2 = rising
    anything else = blank spaces are displayed

For example, to display a pressure of 29.75 inches and rising, set the weather variables as follows:

```
Current barometric pressure - inches = 29
Current barometric pressure - hundredths = 75
Barometric Pressure Direction = 2
```

Wind Variables

The controller can track wind direction and speed:

- Wind direction digit 1
- Wind direction digits 2-3
- Current wind speed
- Today's low wind speed
- Today's high wind speed

Wind direction (in degrees from 0 to 359) requires two variables for storage. The first variable holds the first digit, which can range from 0 to 3. The second variable holds the second and third digits, which can range from 00 to 99. If the first variable is >3, then blanks will be displayed on the weather conditions TV screen.

Wind speed can range from 0 to 254 in increments of 1. A value of 255 is displayed as blank spaces.

For example, to set the current wind direction to due south (180 degrees) and the wind speed to 15, set the weather variables as follows:

```
Wind direction digit 1 = 1
Wind direction digits 2-3 = 80
Current wind speed  = 15
```

Rainfall Variables

Four different rainfall amounts can be tracked, with each requiring two weather variables for storage:

- Today's rainfall - inches
- Today's rainfall - hundredths
- Rainfall this week - inches
- Rainfall this week - hundredths
- Rainfall this month - inches
- Rainfall this month - hundredths
- Rainfall this year - inches
- Rainfall this year - hundredths

The "hundredths" values can range from 0 to 99. Only for the variable "Todays rainfall - inches", a value of >99 is displayed as blank spaces instead of the digits. The other rainfall "inches" amounts are not included on the weather conditions screen and can range from 0 to 255 inches.

For example, to set today's rainfall to 1.29 inches, set the weather variables as follows:

```
Today's rainfall - inches = 1
Today's rainfall - hundredths  = 29
```

Weather Data Commands

```
Weather Variable XXXXX = Constant Value ##
```

Sets the weather variable indicated by XXXXX to the constant value ## (which can range from 0 to 255). This is the primary command to set a weather variable over the serial interface. For example, a computer may be able to determine the temperature is 75 degrees. It would then send this command over the serial interface to set the proper variable to 75 degrees.

```
Read Value Of Weather Variable XXXXX Over Serial Interface
```

This command can only be performed over the serial interface, and not within your schedule. It transmits the value of the weather variable indicated by XXXXX over the serial interface

CHAPTER 11: MISCELLANEOUS

Object Names

The video screen system allows you to display information about many object types on your TV. You can also display the object's name if you've loaded it into the controller. In creating your schedule, you can give names up to 30 characters long to all objects. However, the controller is limited to storing 512 names of 16 characters each. The controller will automatically store the name of all 256 X-10 address, and all input and output ports (24 total). The remaining 232 names can be used for the first 232 infrared signals. Names cannot be displayed for the last 24 IR signals.

As noted above, the PC software can handle names of 30 characters, but the controller can only store the first 16 characters of each name. Subsequent characters will be ignored. If you want the name to be clear when viewed on the video screen, make the first 16 characters descriptive and unique by themselves.

Graphic Background on Main Form

You can display a bitmap graphic on the main software screen. Name the desired bitmap file "backgrnd.bmp" and place it in the same directory as the HomeVision-PC application. At startup, it will be displayed scaled to fill the form.

Exporting Schedule Data

There is an "Export" function on the "File" menu. This command exports a list of the objects in your schedule to a text file. It's provided primarily as a way to send schedule information to other home automation software that several other companies are developing.

Front Panel LEDs

Seven LEDs are provided on the controller's front panel. They are:

- **ON**. On continuously when running. Blinks when the schedule is halted (such as when loading a new schedule). Off while recovering from a power failure.

- **TW-523**. On when the TW-523 module is connected and powered. Also turns on while the controller is recovering from a power failure. After recovery is complete, the LED will turn off if the TW-523 module is not connected.

- **U**. The "U" stands for "user", as this LED is entirely under the user's control. You can turn it on or off at any time by executing the appropriate controller command. The LED always turns off after recovering from a power failure.

- **X-10 RX**. Turns on whenever the TW-523 module detects an X-10 signal on the power line. Will also turn on while the controller is transmitting an X-10 signal, as the TW-523 detects its own transmissions.

- **X-10 TX**. Turns on whenever the controller is transmitting an X-10 signal on the power line.

- **IR RX**. IR RX is short for Infrared Receive. Turns on whenever infrared energy is detected from a remote control unit. Will also turn on while the controller is transmitting from the front panel, as it detects its own transmissions.

- **IR TX**. IR TX is short for Infrared Transmit. Turns on whenever the controller is transmitting (whether from the front panel infrared diode or the external jack on the rear panel).

The first two LEDs can be used to assess the controller's status, as follows:

1) At the initial application of power, the controller will spend a short time recovering from the power failure. During this time, the LEDs will be in the following states:

   "ON" LED will be off

   "TW-523" LED will be on

   "U" LED will be off

   The other LEDs will go on and off as associated X-10 or IR signals are received or transmitted.

2) After the recovery is complete, the "ON" LED will go on and the other LEDs will assume their normal states as described earlier.

3) If the "ON" LED is blinking, the schedule is halted. This is normal while a schedule is being downloaded. There are several other reasons the schedule could be halted:

   - If an error occurs during the schedule load, the controller will remain halted, even if power is cycled. The schedule must be reloaded.

   - If the controller's self-test fails or another serious error occurs, the controller will halt itself. This is done to prevent it from doing unexpected things.

   - If you've executed a "Halt Controller" command from the controller command control screen.

Specifications

- Maximum object quantities:

   - X-10 modules: 256
   - IR Signals: 255
   - Input Ports: 8 or 16
   - Output Ports: 8 or 16
   - Object names loaded into controller: 512 names of 16 characters each

- Learned IR signal memory: Approximately 45,000 bytes. This should be more than enough to hold 255 typical signals.

- X-10 communications:

- Signals supported: All
- Receive buffer: 32 signals
- Transmission: Selectable to transmit on one or all three phases of the AC line
- Collision avoidance: Waits for clear power line plus additional delay before transmitting
- Collision detection: Automatic
- Transmission retry limit (when transmission fails): User selectable from 0 to 31 attempts

- Serial port:

  - Speed: 1200 baud to 19,200 baud
  - Communication settings: 8 data bits, 1 stop bit, no parity

- IR receive and transmit carrier frequency limits: Between 10kHz and 70kHz

- Video format: color baseband NTSC video (PAL video is available as an option)

- On Screen Display capability:

  - Number of rows: 12 (with typically only 11 displayed on most TVs)
  - Number of columns: 24
  - Number of characters available: 90
  - Number of background colors: 8
  - Number of characters sizes: 4
  - Number of blink rates: 4
  - Screen refresh rate: Typically every 10ms or faster

- Battery backup data retention: 12 years minimum

Connectors

Serial Port

The serial port connector is a DB-9 female with the following pin assignments:
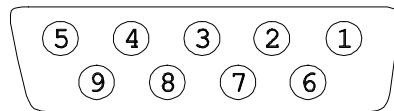
Viewed looking into
end of connector

Pin 2 - TXD (transmit from unit)
Pin 3 - RXD (receive input into unit)
Pin 5 - Ground

All other pins are unused (not connected)

Infrared Transmit Jack

This is a 3.5mm stereo jack. However, only two of the three wires are used. When connecting a stereo plug, the connections are as follows:

- The plug's tip is the infrared output (5V when transmitting, open when not transmitting).
- The plug's body is ground.
- The plug's center ring is not unconnected.

 A mono plug has the same tip and body connections, but no center ring.

Dynamic Data Exchange (DDE)

Dynamic Data Exchange (DDE) is a process by which Windows-based programs can exchange data. The HomeVision-PC software incorporates a DDE interface that programmers can use when writing software to communicate with the controller. This DDE capability is enabled with check boxes on the preferences screen. If you use other software that uses this DDE capability, you will need to enable these check boxes. Otherwise, leave these disabled. If you are a programmer and need information on interfacing with HomeVision-PC via DDE, we can provide you the necessary details.

Controller Error Messages

During operation, the controller constantly checks for errors. If one occurs, an ID number uniquely identifying the error is stored in internal memory. There would normally be no need for you to worry about this. However, if you're experiencing problems or erratic operation, you may want to check for an error.

Table 11-1 provides a brief description of the error ID numbers. Most of the descriptions are probably too cryptic to be of much use to you. However, they may be of help to us in diagnosing your problem.

There are several instances which could lead to errors:

- Sending commands over the serial interface. Errors might occur in the physical interface (perhaps due to noise), or in the format of a command you send. This is especially possible as you're first becoming familiar with the serial interface's command structure and the format of the many commands. One wrong keystroke could potentially cause an error. Extensive error checking is used to reduce this possibility, but it is still possible for errors to occur. In extreme cases, such errors could possibly corrupt the schedule, requiring reloading.

- Failure of the schedule download process. If while you're loading a schedule, power goes out, the serial cable to the controller becomes disconnected, or another error occurs, the load will be incomplete. The controller recognizes this and will remain "halted". If you then command it to restart (with the "Resume Controller" command), an error will occur because the schedule is invalid.

- The schedule memory becomes corrupted. Extensive error checking and data validation is performed by the controller. Should the internal memory somehow become corrupted, the controller should detect the problem and set an error message. You would then have to reload your schedule.

- An invalid infrared signal is received. A few infrared signal types could generate error messages. These will not cause any operational problems.

Table 11-1   Controller Error Message Summary

ID # (hex)	DESCRIPTION
00	OK (no error)
01	Set by ReadRAMTable if desired address is >64K
03	Set by DoAll if CA group header is not FFH
04	Set if RS-232 serial receive buffer overflows
05	Set if RS-232 serial transmit buffer overflows
08	Set by DoOutPort if given an illegal command
09	Set by DoModule if given an illegal command
11	Set by DoAll if given an illegal command type
12	Set by DoOutPort if port ID # > MaxOutPorts
14	Set by Main if last byte of stack is not FFh
15	Set by GetStatus if given an illegal object type
1B	Set by IR High Interrupt if IRInProcess was clear when interrupt occurred
1C	Set by IR High Interrupt if IRRXHigh was set when int occurred
1D	Set by IR Low Interrupt if IRRXHigh was clear when int occurred
1E	Set by Timer 2 Interrupt during IR receive if IRRXHigh is clear
20	Set by DoOutPort if port ID # doesn't agree with ID # in RAM table
23	Set by DoModule if mod. ID # doesn't agree with ID # in RAM table
25	Set by DoInPort if port ID # doesn't agree with ID # in RAM table
26	Set by Main if checksum on first 256 bytes of external RAM <> 0
27	Set by DoInPort if port ID # > MaxInPorts
28	Set by DoInPort if given an illegal command
29	Set by TxBufString if buffer is full
2A	Set by PointToTable if DPTR is not selected upon entry
2B	Set by DoIR if ID # > MaxIRs
2D	Set by GetSizes if object type # is invalid
2E	Set by I2CSendData if there's no acknowledge
2F	Set by GoMaster if there's an I2C bus fault
30	Set by I2CRcvData if there's no acknowledge
31	Set by DoOutPort on full port commands when ID # is too high (>7)
32	Set by HandleInPort if a port which has it's state change bit set is disabled
33	Set by XCheckRx if X-10 receive buffer overflows (and message is lost)
34	Set by SelfTest if any test fails
35	Set by Main if IfLevel<>0
37	Set by DoController if given an illegal command
38	Set by DoIR if given an illegal command
39	Set by DoIR if ID # doesn't agree with ID # in RAM table
3A	Set by DoIR if IR signal type is invalid
3B	Set by Main if an X-10 transmission failed
3C	Set by Timer 2 Interrupt if IR Receive port is low when it times out
42	Set by DoVideo if given an illegal command
45	Set by Main if 82C55 control word is incorrect
50	Set by HandleX10 if received house code is invalid
52	Set by XSendHi if XTxState is invalid
5F	Set by DisplayName if default name type is invalid
64	Set by LogName if default name type is invalid
70	Set by Add24 if result overflows
71	Set by DoWeather if given an illegal command type
72	Set by DoWeather if weather data type is invalid

CHAPTER 12: TROUBLE-SHOOTING

The trouble-shooting procedures are divided into seven topics:

- Problems communicating with the controller
- Infrared signal receive problems
- Infrared signal transmit problems
- Video problems
- X-10 receive problems
- X-10 transmit problems
- X-10 noise/interference problems

Problems Communicating With The Controller

What is the controller's "ON" LED doing?

1) Off:

Is the controller's "TW-523" LED on?

A) Yes:

The controller is recovering from a power failure. It must complete this process before it will be able to receive commands from the serial interface. This process typically only takes a fraction of a second.

B) No:

Are any of the controller's other LEDs on or blinking?

I)   Yes:

Try removing and then reconnecting the power transformer jack several times. The jack can sometimes seem to be inserted properly, but is barely making electrical contact, leading to intermittent operation. If this does not solve the problem, then the controller is defective.

II) No:

Transmit an IR signal or X-10 signal to the controller. Does the appropriate "IR RX" or X-10 RX" LED blink?

a) Yes:

The controller has power. Try removing and then reconnect the power transformer jack. If this does not solve the problem, then the controller is defective.

b) No:

The controller is not running. Try the following:

- Disconnect any devices you have connected to the I/O ports or IR TX jack. A short circuit could be shutting down the controller's internal power supply.
- Remove and then reconnect the power transformer jack.   The jack can sometimes seem to be inserted properly, but is barely making electrical contact, leading to intermittent operation.
- Verify the electrical outlet is functional.

If none of these solve the problem, then the controller or power transformer is defective.

2) On steady or blinking:

If the "ON" LED is on steady, the controller is running. If blinking, the controller is halted. However, it should still communicate over the serial interface. Open the terminal emulator screen under the "Other" menu. Remove then reapply power to the controller. Observe what is shown in the emulator window immediately after power is restored:

A) Garbage characters:

The computer is probably set to a different baud rate then the controller. Try different baud rate settings in the serial port configuration screen (under the "Configure" menu). If none of the baud rates work:

- Verify the serial cable connectors are properly mated and secured.
- Try a different serial cable.
- Reboot your computer and try again. There may be a problem with the serial port.
- Try a different serial port.

If none of these solve the problem, either the controller or the computer's serial port is defective.

B) No characters:

Try the following:

- Verify the computer's communications port is opened (the status will be shown at the bottom right of the main software screen). If not, select the correct serial port from the serial port configuration screen (under the "Configure" menu). If the port will not open, shut down all other applications and try again. If it still won't open, reboot your computer. If it still won't open, there is a problem with your computer.
- Verify the proper computer serial port is selected.
- Verify the computer baud rate is correct. Try each of the baud rate settings on the serial port configuration screen one at a time and see if the computer can communicate with the controller.
- Verify the serial cable is connected and the connectors are properly mated and secured.
- Reboot your computer and try again. There may be a problem with the serial port.
- Try a different serial port.
- Try a different serial cable.

If none of these solve the problem, either the controller or the computer's serial port is defective.

C) Message received OK:

The computer is receiving serial transmissions from the controller OK.   Now check transmissions to the controller. Open the controller command screen under the "Control"

menu. Send the commands to turn the user LED on and off. Does the controller "U" LED change as commanded?

I)   No:

Try the following:

- Verify the serial cable connectors are properly mated and secured.
- Reboot your computer and try again. There may be a problem with the serial port.
- Try a different serial port.
- Try a different serial cable.

If none of these solve the problem, either the controller or the computer's serial port is defective.

II) Yes:

Communications seems to be working. To perform a thorough communications test, open the "Debug" screen under the "Other" menu. Click the "Start" button under the "Serial Comm. Test". The test will run until aborted. The fields display the number of trials and errors. Each trial consists of 512 separate commands of about 12 serial characters each. If there are any errors, then the serial communications is intermittent. If this happens, try the following:

- Verify the serial cable connectors are properly mated and secured.
- Reboot your computer and try again. There may be a problem with the serial port.
- Try a different serial port.
- Try a different serial cable.

If none of these solve the problem, either the controller or the computer's serial port is defective.

IR Receive Problem

Transmit an IR signal to the controller from several feet away. Does the "IR RX" LED blink?

1)   No:

Check the remote's batteries and/or try another remote device. Verify the controller is powered (the "ON" LED is lit). If the "IR RX" LED never blinks, the controller is defective.

2)   Yes:

Open the IR test screen under the "Other" menu. Transmit another IR signal to the controller. Does the "LED" on the IR test screen blink and are the Device Code and Key Code fields filled in (either with numbers or question marks)?

A)   No:

Verify from the status screen (under the "Other" menu) that the controller is running and not halted. If the controller still doesn't report the signals on the IR test screen, check communications with the controller as discussed earlier in this trouble-shooting chapter. If the controller still doesn't report IR signals, it may be defective.

B) Yes:

Are the Device and Key Codes filled in with numbers or question marks?

I)   Numbers:

The controller correctly received IR signals which follow the "standard" format. Test each of your remote's buttons and record their Device and Key Codes. Make sure these codes match those shown:

- On the video remote control configuration screen under the "Configure" menu. These codes are used to navigate through the video screen system.
- On the IR signal summary screen (if you've set up any signals to perform actions when they are received).

If the signal's Device and Key Codes are correct, the controller should respond to the signals (assuming they have been loaded into the controller). If necessary, change the Device and Key Code settings and reload the schedule.

II)   Question Marks:

The remote signal doesn't follow the standard format. This signals cannot be used to control the video screen system or to issue commands to the controller (they can still be "learned" for re-transmission, however). If you expected this signal to follow the standard format and it didn't, try the following:

- Verify your remote is set to the desired code.
- Make sure you've selected the right function on your remote (i.e., TV, VCR, cable, etc.).
- If necessary, you may have to try a different code.

IR Transmit Problem

From the IR control screen, transmit an IR signal that you've previously learned. Does the "IR TX" LED on the controller blink?

1) No:

The signal was not transmitted. Examine the signal using the IR signal summary screen. Is the "Transmit Enabled" box checked? If not, you must enable it and reload the schedule.

> NOTE: The "Transmit Enabled" box shows the setting that will take effect when the schedule is loaded in the controller. It is possible to enable and disable signals from the serial interface of video system; such changes will not be reflected on the IR signal summary screen. If so, you may not realize that it's currently disabled. You can view the current status on the TV screen from the IR signal screen.

If the signal is enabled but the "IR TX" LED still won't blink, the signal may have been learned improperly. Try learning it again, resaving it to your schedule, then reloading it.

2) Yes:

The signal was transmitted. If your equipment did not respond to the signal, try the following:

A) If you're using the controller's built-in LED to transmit, aim the controller squarely at the controller and/or move it closer to the equipment. Verify the jumper (JP) on the circuit board is in place.

B) If you're using an external transmitter to transmit, make sure its cable is plugged into the IR TX jack. Verify the transmitter is properly connected and powered. Aim the transmitter squarely at the controller and/or move it closer to the equipment.

If the signal still does not control the equipment, the signal may have been learned improperly. Try learning it again, resaving it to your schedule, then reloading it. If you cannot get the signal learned properly so that it controls your equipment, contact us. Be prepared to provide the brand name and description of your equipment. It would also be very helpful if you could provide the brand and code number of a programmable remote that works with your equipment. If you do, we can test the signal ourselves to determine why it isn't working.

Video Problem

Is the video output jack providing any video output?

1) <u>No</u>:

Try the following:

- Verify the video cable is properly connected from the controller's video output jack to the video input jack on your TV (or VCR, modulator, etc.).
- Make sure your TV (or other device) has selected the video jack for input. This is a common problem.
- Open the video control screen under the "Control" menu. To provide video text output, perform these commands:

    Stop video system
    Start video menu system

    This should display the video system main menu. If the display is erratic or unclear, refer to the video chapter to make adjustments to the video signal level. If there is still no output at all, the controller may be defective.

2) <u>Yes</u>:

What is the exact problem?

A) <u>Text is blurry</u>:

Refer to the video chapter to make adjustments to the video signal level.

B) <u>Screen appears scrambled</u>:

Refer to the video chapter to make adjustments to the video signal level.

C) <u>External video is not passed through the controller</u>:

Verify the following:

- The video switch is set to the external video position.

- The video cable is properly connected from the output jack of the video source to the controller's input jack.
- The external video source is providing a video signal.

> NOTE: It is usually not possible to connect both of the controller's video jacks to a TV and have the TV act as the video output source. The TV's video output will normally be the same as what's being displayed. If the TV's video input is being received from the controller, and the controller is passing the external video straight through, then the TV will try to display its own output. This is, in effect, an endless loop where the TV really has no video input and cannot display anything. Therefore, the video input source for the controller should normally be another device, such as VCR, cable box, camera, etc..

X-10 Receive Problem

1) Verify the LED on the TW-523 module is lit. If not, make sure it's plugged into a live circuit. If the LED is still not lit, then the TW-523 is defective.

2) Verify the controller's "TW-523" LED is lit. If not, try the following:

- Verify that the phone cable between the controller and the TW-523 module is installed and the connectors are securely mated.
- If you're using your own phone cable, make sure it's a 4-conductor cable. Many cables are only two-conductor and will not work. Test the controller with it's original cable.
- Try using a different TW-523 module.

If the controller's "TW-523" LED still does not light, check communications with it as described earlier. If communications are OK, but the "TW-523" LED will not light when the TW-523 module is properly installed, the controller is defective (although this particularly failure is extremely unlikely).

3) Open the X-10 control screen from the "Control" menu. Transmit X-10 signals to the controller using a mini-controller or other X-10 transmitting device. Are the X-10 signals reported on the control screen?

A) No:

Does the controller's "X-10 RX" LED blink when the signal is transmitted?

I) Yes:

Try the following:

- Verify the controller is running (not halted) by using the status screen under the "Other" menu. If halted, either resume it or reload your schedule.
- Verify communications with the controller as described earlier.
- Try using a different TW-523 module.

If none of these solve the problem, the controller may be defective.

II) No:

Does the LED on the TW-523 module blink when the signal is transmitted?

a) <u>Yes</u>:

Try the following:

- Verify that the phone cable between the controller and the TW-523 module is installed and the connectors are securely mated.
- If you're using your own phone cable, make sure it's a <u>4-conductor</u> cable. Many cables are only two-conductor and will not work. Test the controller with it's original cable.
- Try using a different TW-523 module.

If none of these solve the problem, either the TW-523 module or the controller is defective (although this particularly failure is extremely unlikely).

b) <u>No</u>:

Either the signal is not reaching the TW-523 module or the TW-523 is defective. Try plugging an X-10 appliance module (or other receiver) into the same outlet as the TW-523. See if it responds to the X-10 signals. If it responds but the TW-523 LED doesn't blink, the TW-523 is defective. If the appliance module doesn't respond either, the problem is elsewhere in your house. Refer to "X-10 Noise/Interference Problems" for help is isolating this type of problem.

B) <u>Only some signals are reported</u>:

The problem is probably with the X-10 signals traveling through your household wiring. Refer to "X-10 Noise/Interference Problems" for help is isolating this type of problem.

C) <u>Yes, all signals are reported</u>:

The controller is properly receiving X-10 signals.

X-10 Transmit Problem

1) Verify the LED on the TW-523 module is lit. If not, make sure it's plugged into a live circuit. If the LED is still not lit, the TW-523 is defective.

2) Verify the controller's "TW-523" LED is lit. If not, try the following:

- Verify that the phone cable between the controller and the TW-523 module is installed and the connectors are securely mated.
- If you're using your own phone cable, make sure it's a <u>4-conductor</u> cable. Many cables are only two-conductor and will not work. Test the controller with it's original cable.
- Try using a different TW-523 module.

If the controller's "TW-523" LED still does not light, check communications with it as described earlier. If communications are OK, but the "TW-523" LED will not light when the TW-523 module is properly installed, the controller is defective (although this particularly failure is extremely unlikely).

3) Open the X-10 control screen from the "Control" menu. Use it to transmit an X-10 signal to a device you can observe. What message is reported at the bottom of the window"?

A) "Command Failed - No Controller Response" or "Command Failed - Invalid Controller Response":

This could occur if the controller is halted or if there was a communications problem between the controller and the computer. Open the status screen under the "Other" menu and read the controller's status. If the controller is halted or there are other errors, reload your schedule. If there are no errors, refer to the communications troubleshooting section to verify proper communications.

B) "Command Executed":

The controller transmitted the signal. Did the device respond properly?

I)   Yes:

The transmission worked.

II) No:

Did the controller's "X-10 TX" LED blink when the signal was transmitted?

a) No:

This could occur if the controller is halted or experienced an error. Open the status screen under the "Other" menu and read the controller's status. If the controller is halted or there are other errors, reload your schedule. If no errors are reported, try transmitting again. If this problem persists, the controller may be defective.

b) Yes:

Did the LED on the TW-523 module blink when the signal was transmitted?

i)   Yes:

The command was properly transmitted. The problem is probably with the X-10 signals traveling through your household wiring.   Refer to "X-10 Noise/Interference Problems" for help is isolating this type of problem.

ii) No:

Try the following:

- Verify that the cable between the controller and the TW-523 module is installed and the connectors are securely mated.
- If you're using your own phone cable, make sure it's a 4-conductor cable. Many cables are only two-conductor and will not work. Test the controller with it's original cable.

If these do not solve the problem, the TW-523 module is probably defective. There is a very slight chance that the controller is defective.

X-10 Noise/Interference Problems

X-10 systems often experience problems with the signals properly transmitting through household wiring. If your X-10 communications are intermittent or only some module work, try the following:

- Try plugging either the controller of the X-10 transmitter/receiver into a different electrical outlet. If the controller and the X-10 device are on different electrical circuits, you may need a phase coupler or amplifier to ensure proper communications. This is especially true with larger houses, where the signal gets attenuated significantly.

- Make sure the controller's TW-523 module and other X-10 devices are not plugged into a surge protector. These sometimes filter out the X-10 signal.

- Turn off other electrical appliances. Some of these can generate noise and drown out the X-10 signals. Filters are available that can eliminate this problem.

APPENDIX A: FCC RULES

FCC Rules Part 15 - Digital Devices

The United States Federal Communications Commission has specified that the following notice be brought to the attention of users of this product.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try and correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

The user may find the following booklet, prepared by the Federal Communications Commission, helpful: How to Identify and Resolve Radio/TV Interference Problems. This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 004-000-00345-4.

Use of shielded cables for the video and input/output ports is required to comply with Class B limits of Part 15 of the FCC rules.

Any changes or modifications to this equipment not expressly approved by Custom Solutions, Inc. may cause harmful interference and void the FCC authorization to operate this equipment.

APPENDIX B: ASCII CODE CHART

```
                      Most Significant Figure

        HEX|| 0   | 1   | 2   | 3   | 4   | 5   | 6   | 7   |
        ===++=====+=====+=====+=====+=====+=====+=====+=====+
         0 || NUL | DLE |     | 0   | @   | P   | `   | p   |
        ---+-----+-----+-----+-----+-----+-----+-----+-----+
         1 || SOH | DC1 | !   | 1   | A   | Q   | a   | q   |
      L ---+-----+-----+-----+-----+-----+-----+-----+-----+
      e  2 || STX | DC2 | "   | 2   | B   | R   | b   | r   |
      a ---+-----+-----+-----+-----+-----+-----+-----+-----+
      s  3 || ETX | DC3 | #   | 3   | C   | S   | c   | s   |
      t ---+-----+-----+-----+-----+-----+-----+-----+-----+
         4 || EOT | DC4 | $   | 4   | D   | T   | d   | t   |
      S ---+-----+-----+-----+-----+-----+-----+-----+-----+
      i  5 || ENQ | NAK | %   | 5   | E   | U   | e   | u   |
      g ---+-----+-----+-----+-----+-----+-----+-----+-----+
      n  6 || ACK | SYN | &   | 6   | F   | V   | f   | v   |
      i ---+-----+-----+-----+-----+-----+-----+-----+-----+
      f  7 || BEL | ETB | '   | 7   | G   | W   | g   | w   |
      i ---+-----+-----+-----+-----+-----+-----+-----+-----+
      c  8 || BS  | CAN | (   | 8   | H   | X   | h   | x   |
      a ---+-----+-----+-----+-----+-----+-----+-----+-----+
      n  9 || HT  | EM  | )   | 9   | I   | Y   | i   | y   |
      t ---+-----+-----+-----+-----+-----+-----+-----+-----+
         A || LF  | SUB | *   | :   | J   | Z   | j   | z   |
      F ---+-----+-----+-----+-----+-----+-----+-----+-----+
      i  B || VT  | ESC | +   | ;   | K   | [   | k   | {   |
      g ---+-----+-----+-----+-----+-----+-----+-----+-----+
      u  C || FF  | FS  | ,   | <   | L   | \   | l   | |   |
      r ---+-----+-----+-----+-----+-----+-----+-----+-----+
      e  D || CR  | GS  | -   | =   | M   | ]   | m   | }   |
        ---+-----+-----+-----+-----+-----+-----+-----+-----+
         E || SO  | RS  | .   | >   | N   | ^   | n   | ~   |
        ---+-----+-----+-----+-----+-----+-----+-----+-----+
         F || SI  | US  | /   | ?   | O   | _   | o   | DEL |
        ---+-----+-----+-----+-----+-----+-----+-----+-----+
```

APPENDIX C: WARRANTY

Three Year Limited Warranty

WARRANTOR: Custom Solutions, Inc.

ELEMENTS OF WARRANTY: Custom Solutions, Inc. warrants, for the duration of this warranty, HomeVision-PC (hereafter referred to as the "Product") to be free from defects in materials and workmanship with the limitations or exclusions set out below.

WARRANTY DURATION: This warranty shall terminate and be of no further effect three years after the date of original purchase of the Product or at the time the product is (A) damaged or not maintained as reasonable and necessary, (B) modified, (C) improperly installed, (D) repaired by someone other than the warrantor for defect or malfunction covered by this warranty, (E) used in a manner or purpose for which the product was not intended, (F) damaged by an act of God (such as a lightning strike), or (G) sold by the original purchaser.

STATEMENT OF REMEDY: In the event the product does not conform to this warranty at any time while this warranty is in effect, the warrantor shall repair the defect and return it to you without charge for parts, service, or any other costs incurred by the warrantor or its representative in conjunction with the performance of this warranty. THIS WARRANTY DOES NOT COVER OR PROVIDE FOR THE REIMBURSEMENT OR PAYMENT OF INCIDENTAL OR CONSEQUENTIAL DAMAGES. THIS INCLUDES DAMAGE CAUSED BY THE PRODUCT DUE TO A PRODUCT DEFECT OR INCORRECT APPLICATION OF THE PRODUCT. Some states do not allow this exclusion or limitation of incidental or consequential damages, so the above exclusion or limitation may not apply to you.

PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY: In the event that the Product does not conform to this warranty, you may return the unit to the company you purchased it, or to Custom Solutions, Inc. To return it to Custom Solutions, call 407-726-8864 to obtain a Return Material Authorization number (RMA #). Any unit returned without an RMA # clearly marked on the exterior package will be refused and returned at the sender's expense. Ship the Product, freight prepaid, along with evidence of original purchase, to the warrantor at:

Custom Solutions Inc.
1705 Canterbury Drive
Indialantic, FL 32903

LEGAL REMEDIES: This warranty specific legal rights, and you may also have other rights that vary from state to state.