

ACS-7630 Controller User Manual



IDE to IDE RAID Controller

ACS-7630 User Manual

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Preface

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This manual version 2.0a

About this manual

Intended user

This manual is designed and written for users of the ACS-7630 RAID controller. The user should ideally be familiar with RAID planning and data storage operations and have experience in electronic or computer engineering.

Organization of the manual

This manual consists of the following sections:

- Chapter 1: **Introduction** provides details of key features, checklists of package contents and user requirements, and an overview of the controller box and its features.
 - Chapter 2: **Before you begin** contains all the information you need to decide whether to set up a RAID 0 or RAID 5 array and lists important pre-installation notices.
 - Chapter 3: **Setting up the controller** guides you through process of installing ACS-7630 in a system or externally and explains how to replace drives.
 - Chapter 4: **Initializing the array** explains how to launch the automatic initialization process.
 - Chapter 5: **Formatting** tells you how partition and format the array so that your system can start using it.
-
- Appendix A: **FAQ** helps you deal with encountered problems in the form of Q&A.
 - Appendix B: **Glossary** defines relevant technical terms used in this manual.
 - Appendix C: **Specifications** list technical specification of ACS-7630.
 - Appendix D: **Regulatory Information** provides information of related certification and standards.
 - Appendix E: **Contact Us** lists contact details of Accusys business units around the world.

Using this manual

This guide contains all the information you need to set up and start using your RAID controller and to monitor its performance in real time. The setup process will follow these steps:

Step 1

Prepare: Familiarize yourself with the features and capabilities of ACS-7630 (**Chapter 1**)
Decide whether to set up a RAID 0 or RAID 5 array (**Chapter 2**)

Step 2

Configure: Set the RAID and Master / slave configurations (**Chapter 3**)

Step 3

Install: Attach the necessary cables and either mount the controller box inside your system or set up the controller box externally (**Chapter 3**)

Step 4

Initialize: Initialize the array (**Chapter 4**)

Step 5

Format: Partition the array to enable your computer's operating system to begin using it (**Chapter 5**)
Format the array (**Chapter 5**)

When you have reached this point, your RAID controller will be ready for use. To get the most from ACS-7630, you should also set up the ACSView GUI on your system. With this browser you can monitor the status of your array at any time and from any computer on your LAN. You will find full installation instructions and information on the monitoring capabilities of ACSView in the ACS-7630 ACSView User's Manual. Ask your vendor for details.

Guide to Conventions

Important information that users should be aware of is indicated with the following icons:



Caution

This icon indicates the existence of a potential hazard that could result in personal injury, damage to your equipment or loss of data if the safety instruction is not observed.



Note

This icon indicates useful tips on getting the most from your RAID controller.

Important terms, commands and programs are put in **Boldface** font.

Screen text is given in `screen` font.

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Chapter 1

Introduction

This chapter introduces the features and capabilities of ACS-7630.

You will find:

- ⇒ A full introduction to your ACS-7630 controller
- ⇒ Details of key features
- ⇒ A checklist of package contents
- ⇒ A checklist of what else you need to start installation
- ⇒ An overview of the controller box and its features, including connectors, LEDs and jumpers

Overview

Congratulations on your selection of the Accusys 7630 (ACS-7630). The ACS-7630 is a high-performance and extremely flexible RAID (Redundant Array of Independent/Inexpensive Disks) controller. RAID is a storage technology used to improve the processing capabilities of a storage system, providing a combination of reliability and performance.

The ACS-7630 is the ultimate approach to a flexible RAID solution. It can manage two different RAID levels (0 and 5), with three IDE disks in a single RAID group. With a cost-effective IDE approach, supporting Ultra DMA mode, the ACS-7630 strips data to three disk drives simultaneously, and delivers optimized performance, comparable to more costly SCSI based solutions.

Featuring intelligent online recovery, the ACS-7630 lets you hot swap a failed drive: data will automatically be rebuilt to the new drive without any system down time. If a RAID 5 array exists and one IDE disk drive fails, data is secured by the other drives, and an alarm sounds to alert you. RAID 5 rebuild will proceed automatically (during power on) as soon as you lock the disk carrier. If a RAID 0 array fails, there is no way to recover the data of the RAID system. You should proceed by reconfiguring the new RAID with a new IDE disk.

The ACS-7630 Controller Box features a user-friendly rack design that lets you easily install three drives. Each drive carrier supports a one-inch high 3.5-inch form factor drive. Security is provided by a key-locking system that prevents unauthorized access to each disk drive.

Key features

The ACS-7630 supports the following features:

- Automatic on-line rebuilding
- Drives are hot swappable
- Supports RAID level 0 and 5
- Can be configured as master or slave IDE drive
- Host transparent and OS independent
- Fan cooler (Ball bearing type)
- Supports 3 IDE hard drives
- Key locking to prevent unauthorized access to the disk drives
- Requires no software drive or add-in card
- Audible alarm on drive failure

Hard drive hot swapping

Hot Swapping allows for the removal and installation of disk drives without the need to power down the system while ACS-7630 is configured as a RAID 5 array.

Automatic drive rebuilding

If a member drive in a RAID 5 array is replaced on-line, the controller will automatically start to rebuild data to the new drive.

Making sure you have everything

What's in the box

Some vendors may ship certain components as standard, while other vendors treat the same component as optional. In its most basic configuration, your package should include the following:

- ACS-7630 Controller Box
- ACS-7630 Controller User's Manual
- Three disk drive carriers with key locks
- Disk drive mounting screws
- Two keys for drive carriers (identical)

What else you need

In order to setup a working system the following user-supplied items are required:

- System with IDE/ATA Interface
- Case with two half-height 5 ¼" drive bays with front bezel access
- One IDE channel cable connector
- One free power supply connector

One 3-pin RS232 cable connector (data connection for GUI interface, if required)

Familiarizing yourself with the controller

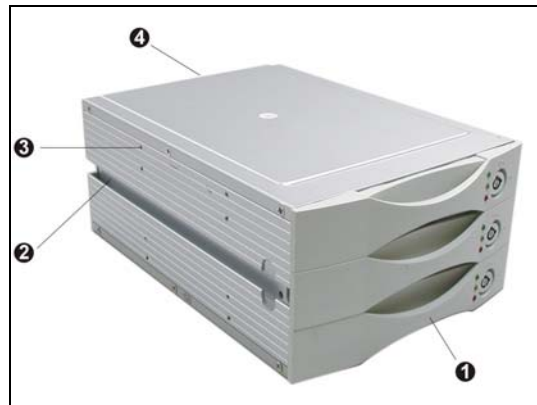
Overview

The Controller Box has three **drive carriers**, accessed from the front.

The sides of the box each feature a **guide rail channel** and **mounting screw holes** to enable the box to be secured inside a computer case.

The **connectors and jumpers** are located on the rear panel.

❶	Front / Drive carriers
❷	Guide rail channel
❸	Holes for mounting screws
❹	Rear / Connectors & jumpers



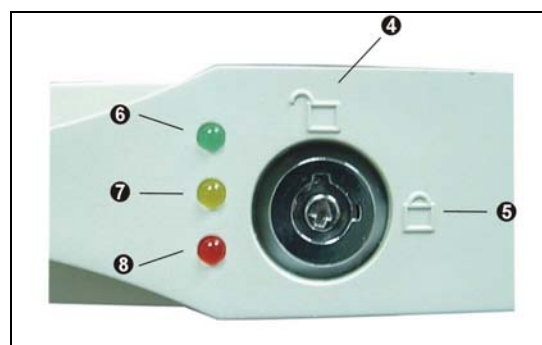
Front view

❶	Three Drive Carriers
❷	Disk Activity Indicators
❸	Drive Carrier Lock



Each drive carrier can hold a one-inch high 3.5-inch form factor IDE disk drive. This makes it easy to hot swap a drive in the event of a failure, without affecting the status of the remaining drives.

❹	Drive Carrier Lock – Unlocked orientation
❺	Drive Carrier Lock – Locked orientation
❻	Green Disk Activity Indicator
❼	Amber Disk Activity Indicator
❽	Red Disk Activity Indicator



Disk Activity Indicators

These indicators show the status of each individual disk drive.

Indicator	Disk Activity
Green	Disk drive is properly installed and locked
Amber	Disk drive is being accessed
Red	Disk drive is not present, is not properly installed, is unlocked, or disk has failed
Red Flashing	Disk drive is rebuilding data

In the event that a drive fails, the Red indicator turns on and an alarm sounds. You can turn off the alarm by unlocking the drive carrier.

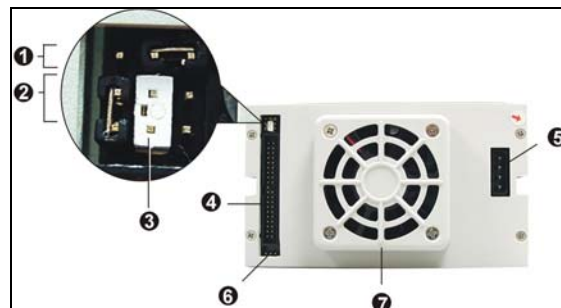
The drive carrier lock acts as an On/Off switch for the drives and provides security by preventing non-key holders from accessing the drives.

To lock each carrier, insert the key and turn it in a clockwise direction. To unlock a carrier, turn the key in a counterclockwise direction.



Rear view

❶	Master/Slave configuration jumper pins
❷	RAID level configuration jumper pins
❸	Jumper head
❹	Connector for IDE 40-pin interface cable
❺	Power connector
❻	3-pin RS232 connector (Terminal port)
❼	Cooling fan vent



The settings for the **master / slave** and **RAID configuration jumpers** are described in Chapter 3.

The **IDE cable** is the route used for reading and writing to the array.

The **power connector** supplies power to the controller box.

The **3-pin RS-232 cable** is used for remote monitoring of ACS-7630. The RS-232 port is configured with DTE and PC compatible pin assignments.

The **cooling fan** inside the controller box provides air circulation for the disk drives.

Chapter 2

Before you begin

This chapter contains includes all the information you need to decide which RAID level to use and to prepare for installation.

You will find:

- ⇒ A full introduction to and comparison of RAID levels 0 and 5
- ⇒ Important notices on the safe operation and installation of ACS-7630

Pre-installation planning

Introduction to RAID levels

The ACS-7630 can support the following RAID levels: 0 and 5. Which is the right level for you? The answer depends on the application it is used for.

RAID Level 0 offers high transfer rates, and is ideal for large blocks of data where speed is of importance. Computer Aided Design, Graphics, Scientific Computing, Image and Multimedia applications are all good examples. If one drive in a RAID 0 array fails however, the data on the whole array is lost.

RAID Level 5 arrays offer high I/O transaction rates, and are the ideal choice when used with on-line transaction processing applications, such as those used in banks, insurance companies, hospitals, and all manner of office environments. These applications typically perform large numbers of concurrent requests, each of which makes a small number of disk accesses. If one drive in a RAID 5 array fails, the lost data can be rebuilt from data on the functioning disks.

Further information on RAID concepts can be found in Appendix B, Glossary.

RAID 0

RAID 0 links each drive in the array as one huge drive. Storage capacity is determined by the smallest drive in the array. That capacity is then applied to format all other drives in the array. If using a 40 GB, 60 GB, and 50 GB drive in a RAID 0 array, your system will see one huge drive of 120 GB (40 GB×3).

RAID 0 offers double or more performance under sustained data transfers when one drive per ATA port is used. In such a configuration, unlike SCSI, ATA drives are always available to the system. SCSI requires more management of the SCSI bus.

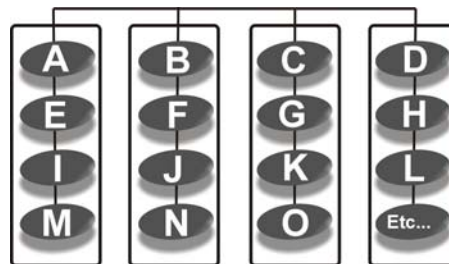
RAID 0: *Striped disk array without fault tolerance*

Characteristics:

- RAID 0 implements a striped disk array, the data is broken down into blocks and each block is written to a separate disk drive.
- I/O performance is greatly improved by spreading the I/O load across many channels and drives.
- Fastest and most efficient array type but offers no fault-tolerance.
- Storage capacity = (No. of disks) × (capacity of smallest disk)

Recommended use:

- Video production and editing
- Image editing
- Pre-press applications
- Any application requiring high bandwidth



Arrangement of data blocks saved on a Level 0 RAID

RAID 5

RAID 5 uses a mathematical expression that compares data from two drives and calculates a third piece of data called “parity”. Should one of the drives fail, parity data can be used to rebuild the failed data. Under RAID 5, parity data is stored across all drives in the array. This maximizes the amount of storage capacity available from all drives in the array while still providing data redundancy.

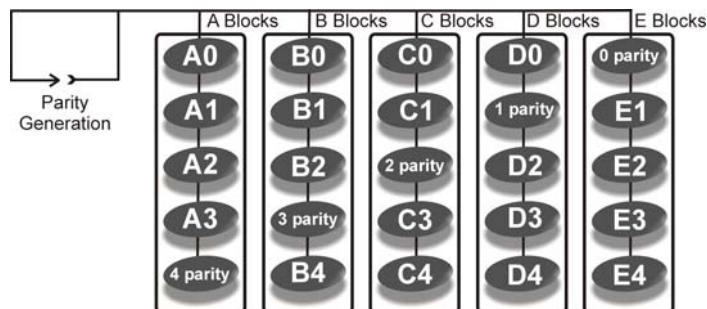
RAID 5: *Independent data disks with distributed parity blocks*

Characteristics:

- Each entire data block is written on a data disk. Parity for blocks in the same rank is generated on Writes, recorded in a distributed location and checked on Reads.
- Highest Read data transaction, medium Write data transaction rate.
- Relatively low ratio of ECC (Parity) disks to data disks means high efficiency (compared to other RAID levels).
- Good aggregate transfer rate.
- Storage capacity = (No. of disks – 1) × (capacity of smallest disk)

Recommended use:

- File and application servers
- Database servers
- WWW, E-mail and News servers
- Intranet servers
- Most versatile Raid level



Arrangement of data and parity blocks saved on a Level 5 RAID

Pre-installation notices



Caution

Before starting any kind of hardware installation, please ensure that all power switches have been turned off and all power cords disconnected to prevent personal injury and damage to the hardware.



Caution

To avoid overheating, ACS-7630 should be installed in a well-ventilated area and in such a way that sufficient airflow is maintained across the controller chips.



Caution

Static electricity can damage electronic components. To guard against such damage:

Work in a static-free environment

Wear a grounded anti-static wrist strap

Store uninstalled components in anti-static bags

Handle PCBs by their edges and avoid touching chips and connectors.



Caution

Environmental requirements: Temperature: 5-44C

Humidity: 10-95%, non-condensing

Altitude: Sea level to 10,000 ft

Chapter 3

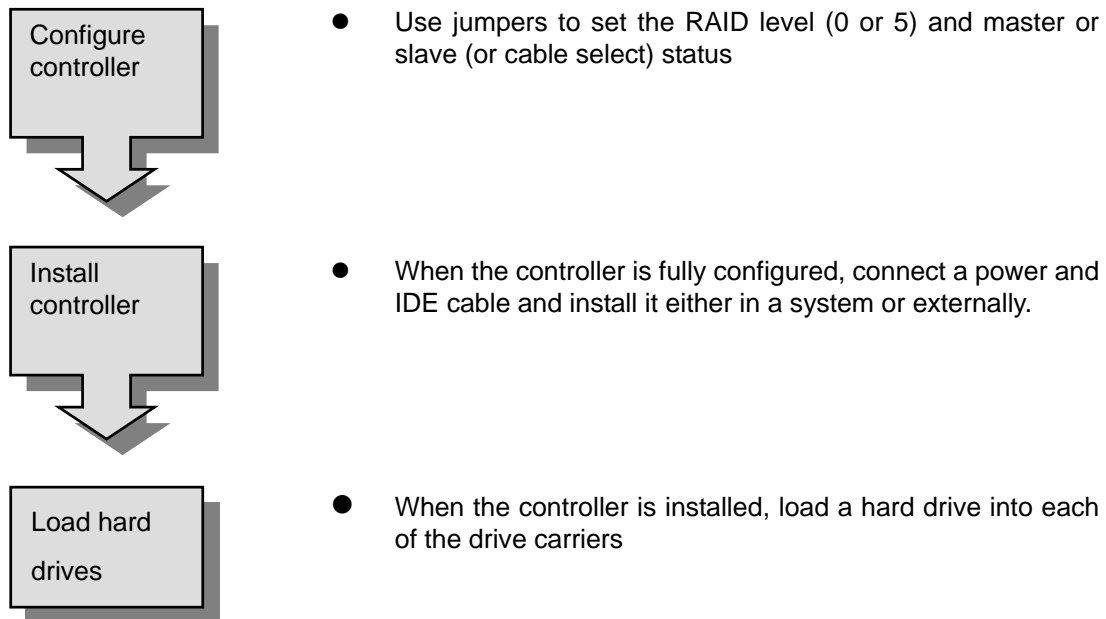
Setting up the controller

This chapter explains how to:

- ⇒ Set RAID level on controller box
- ⇒ Set master, slave or cable configuration on controller box
- ⇒ Install the RAID controller in a system or externally
- ⇒ Load hard drives into ACS-7630
- ⇒ Swap drives

Installation flowchart

Installation of ACS-7630 is simple. This chapter will lead you through the following steps:



Setting configurations

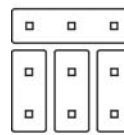
The RAID (level 0 or 5) and master / slave configurations are set manually by placing jumper heads on the nine jumper pins on the rear of the controller box.

- | | |
|---|----------------------------------------|
| ❶ | Master/Slave configuration jumper pins |
| ❷ | RAID level configuration jumper pins |



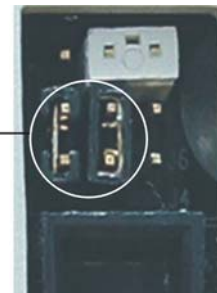
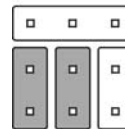
RAID 0 configuration

1. Make sure the power is turned off.
2. Make sure the six RAID configuration jumper pins are clear of any jumper caps.



RAID 5 configuration

1. Make sure the power is turned off.
2. Place two jumper caps over the central and left pairs of RAID configuration jumper pins.





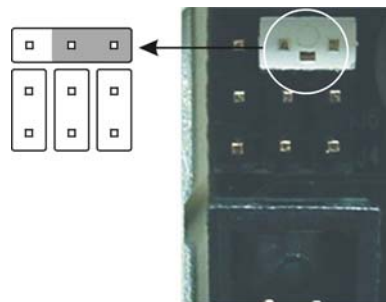
Note

Master, slave and cable select settings enable your computer to distinguish two IDE/ATA devices operating on the same channel. In this case, the settings distinguish ACS-7630 from your computer's hard disk drive.

It makes little difference which setting you use, but if using master or slave, you must make sure that the two devices' settings are different. So, if the HDD is configured as the master drive, ACS-7630 should be configured as slave, and vice versa. If using cable select, both devices must use cable select.

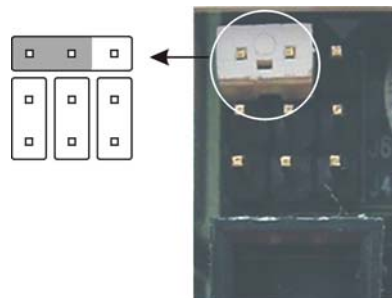
Master configuration

1. Make sure the power is turned off.
2. Place one jumper cap over the central and right master/slave configuration jumper pins.



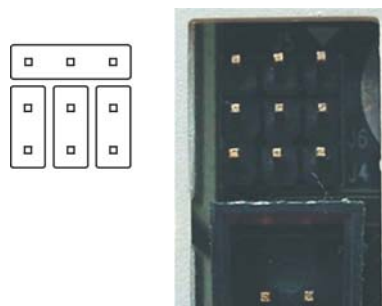
Slave configuration

1. Make sure the power is turned off.
2. Place one jumper cap over the central and left master/slave configuration jumper pins.



Cable select configuration

1. Make sure the power is turned off.
2. Ensure the three master/slave configuration jumper pins are clear of any jumper caps.



Mounting controller box

The ACS-7630 controller box can be installed inside a computer case or set up externally. This section describes both procedures.



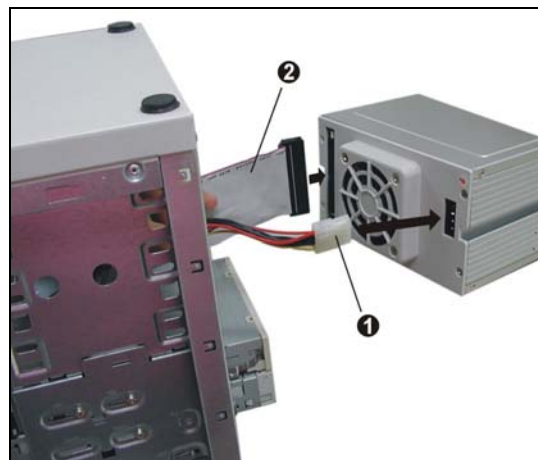
Caution

Turn off and disconnect all electrical power from the system before beginning installation.

Mounting controller box in system

The ACS-7630 controller box fits into the space of two half-height 5¼-inch drive bays.

1. Remove the cover and front bezel from the system case.
2. Feed a power cable ❶ through the opening.
3. Feed a 40-pin IDE cable ❷ through the opening.
4. Connect the two cables to the connectors on the rear of the controller box.
5. If planning to use the ACSView GUI to monitor the status of your RAID, you should also connect a 3-pin RS-232 cable to the terminal on the controller box.
6. Insert the controller box into the bay, and secure it in place with the screws provided. (If your case uses guide rails to install 5¼-inch devices, you can use them on the controller box.)



Installing controller box externally

The ACS-7630 may also be set up outside a computer case and connected to a system via the ACS-2720 IDE to IEEE 1394 converter board. The ACS-2720 (supplied separately) has two ports allowing simultaneous access to the RAID by two hosts.

If planning to use the ACSView GUI to monitor the status of your RAID, you should also connect a 3-pin RS-232 cable to the terminal on the controller box.

Loading drives in the controller box



Note

We recommend that you use one of the following hard disk brands: Fujitsu, IBM, Maxtor, Quantum, or Seagate.



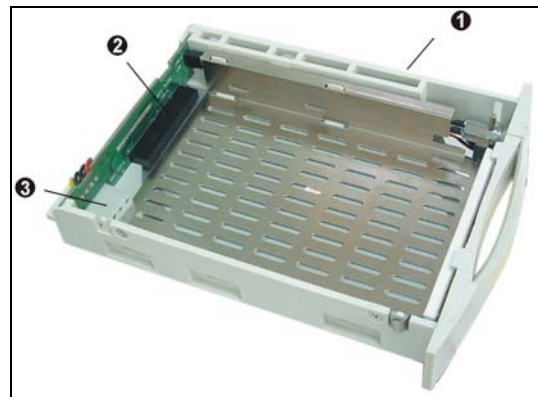
Note

All three hard disks should be configured as **Master**.

There are two types of drive carrier available:

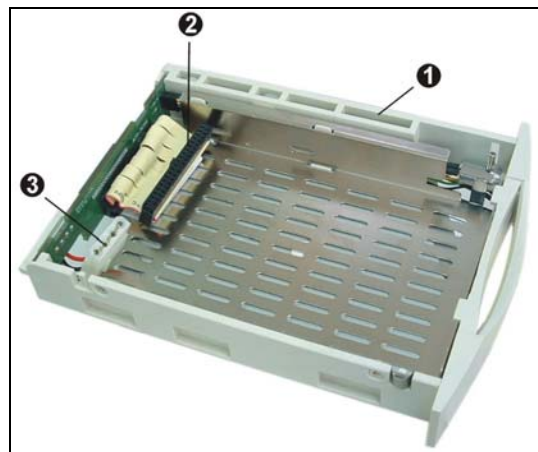
1. Fixed IDE connector

- | | |
|---|---------------------|
| ① | Drive Carrier |
| ② | Fixed IDE Connector |
| ③ | Power Connector |



2. Cable IDE connector

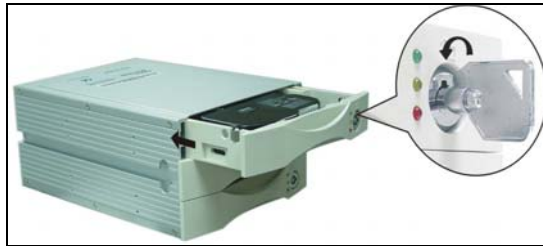
- | | |
|---|---------------------|
| ① | Drive Carrier |
| ② | Cable IDE Connector |
| ③ | Power Connector |



Fixed connector drive carrier

The ACS-7630 should be fitted with three hard disk drives (HDDs). Load each drive into a drive carrier as follows:

1. Unlock the drive carrier and slide it out of the controller box.
2. Place the disk drive in the drive carrier, so that the power and IDE connectors are lined up with the connectors inside the carrier.
3. Connect the power connector to the disk drive first, then carefully push the disk drive so that the drive's IDE connector is seated securely into the IDE connectors in the disk carrier.
4. Push the power connector into the drive connected to ensure it is firmly secured.
5. Secure the disk drive by screwing it to the drive carrier case.
6. Slide the loaded disk drive carrier into the ACS-7630 Controller Box and lock it.



Note

The disk carrier connector at the back of each controller box disk carrier slot can be damaged if the disk carrier is not properly aligned when inserted. Insert the disk carrier gently to avoid damage.

Cable connector drive carrier

The ACS-7630 should be fitted with three hard disk drives (HDDs). Load each drive into a drive carrier as follows:

1. Unlock the drive carrier and slide it out of the controller box
2. Place the disk drive at an angle in the drive carrier and connect the power connector ❶ to the disk drive
3. Carefully connect the drive's IDE connector ❷ to the drive carrier connector.
4. Slide the disk drive into position in the carrier, taking care not to damage the IDE or power cables.
5. Secure the disk drive by screwing it to the drive carrier case.
6. Slide the loaded disk drive carrier into the ACS-7630 Controller Box and lock it.



Note

The disk carrier connector at the back of each controller box disk carrier slot can be damaged if the disk carrier is not properly aligned when inserted. Insert the disk carrier gently to avoid damage.

Removing / replacing a drive

Swapping drives

The hot swap function is available on the RAID 5 array and can be operated during run time. RAID rebuilding will be processed automatically in the background and the ACS-7630 RAID subsystem will record its progress. If the host system is shut down or powered off abnormally, the ACS-7630 RAID subsystem will continue the disk rebuilding process after power is turned on again.



Note

A hard disk should not be replaced when the system is turned off. Doing so may lead to loss of data. Always hot swap disks in a RAID5 array.

What if a disk fails?

If a disk drive fails, or a key switch is turned off, the red disk activity indicator of its disk carrier will light and the alarm will sound. When this happens, you can replace the failed IDE disk with a new one, then turn the key switch on.



Note

*The failure or removal of a single drive in a **RAID5** array **will not** lead to failure of the array. The failure or removal of a single drive in a **RAID0** array **will** lead to loss of all data on the array and the entire array must be re-initialized.*

Removing a drive from a fixed connector drive carrier

1. Unlock the appropriate disk carrier. The red disk activity indicator will light.
2. Slide the drive carrier out of its slot.
3. Slide the disk drive to the front of the carrier so that the IDE connector is freed from the drive carrier.
4. Make sure the power connector is also detached.
5. Lift out the disk drive.



Removing a drive from a cable connector drive carrier

1. Unlock the appropriate disk carrier. The red disk activity indicator will light.
2. Slide the drive carrier out of its slot.



3. Lift the disk drive slightly out of the carrier and detach the power ❶ and IDE ❷ connectors.
4. Lift out the disk drive.



Chapter 4

Initializing the array

Once ACS-7630 is set up and connected, the array should be initialized. The initialization process is automatic.

- If system power is off and ACS-7630 is fully set up, simply turn on system power. The system will detect the presence of ACS-7630 and ACS-7630 will check the status of the HDDs. Initialization will start.
- If system power is already on, key off then key on each of the drives in turn. You should wait for the green disk activity indicator to light for each drive before keying on the next drive.

Initialization and RAID status is shown by the disk activity indicators. Once a drive has been located and its working status confirmed, the green indicator for that drive will light.



Indicator	Disk Activity
Green	Disk drive is properly installed and locked
Amber	Disk drive is being accessed
Red	Disk drive is not present, is not properly installed, is unlocked, or disk has failed
Red Flashing	Disk drive is rebuilding data

If a red disk activity indicator shows, check to make sure the appropriate drive is:

- Locked
- Installed correctly
- Not faulty (if necessary, the drive should be replaced).

During array initialization, the following will be observed:

Indicator	Status
Green	Solid
Amber	Solid
Red	Flashing
Alarm	Intermittent



Note

If system power is turned off midway through array initialization, the process will continue from its point of interruption when power returns.

Chapter 5

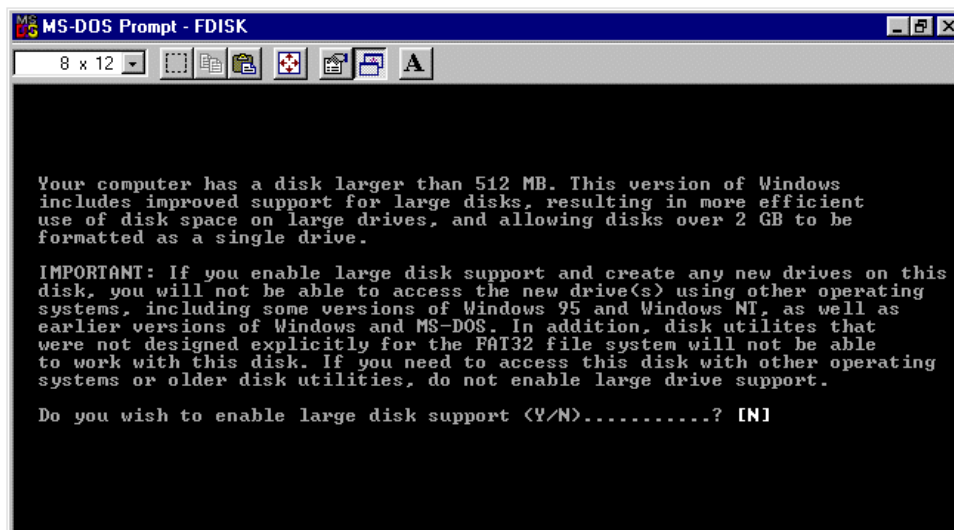
Formatting

This chapter explains how to partition and format the array.

Partitioning the array

The array must be partitioned before it can be used. To do this:

1. Boot to DOS (with bootable floppy disk).
2. Type `fdisk`. Press **Enter**. The following screen will appear:



3. When asked `Do you wish to enable large disk support (Y/N).....?` type `y`. Press **Enter**.
4. The **FDISK options menu** will appear. Select **Change current fixed disk drive**.
5. Each of your current fixed disk drives, including the ACS-7630 RAID controller, will be listed. Select ACS-7630. You can identify ACS-7630:
 - From the order in which the drives are listed. This corresponds to the master (1) / slave (2) configuration you set for the array and primary system hard drive
 - From the drive capacity. The capacity of a RAID0 array is calculated as (No. of disks) × (capacity of smallest disk). The capacity of a RAID5 array is calculated as (No. of disks – 1) × (capacity of smallest disk)



Note

Take care to ensure that you select the correct drive. Data is destroyed during disk formatting.

6. The screen will return to the **FDISK Options menu**. Select **Create DOS partition or Logical DOS Drive**.
7. Select **Create Primary DOS Partition**.
8. When asked **Do you wish to use the maximum available size for a Primary DOS Partition type [Y]**.
9. The following message will appear: **Primary DOS Partition created, drive letters changed or added**. Press **Esc** to continue.
10. The screen will return to the **FDISK Options menu**. Press **Esc** to exit **FDISK**.

Formatting the array

1. Reboot the computer to DOS with a bootable floppy disk.
2. When the **A:\>** prompt appears, type **format d:**
3. You will be asked if you want to proceed. Type **y** and press **Enter**.
4. Formatting will begin.

Appendix A

FAQ

If you encounter a problem while using the ACS-7630, check this section for help.

1. When I lock a drive carrier with a disk drive in place, the red disk activity indicator turns on and an alarm beep sounds. Why?

- (a) Make sure you firmly connect the IDE and Power connectors of the HDD to their counterparts inside the drive carrier and try again. If this does not solve the situation, go to (b).
- (b) Change the disk drive with a new one and try again.
- (c) Exchange the top and bottom drive carriers and try again to determine if the carrier itself is faulty.
- (d) If all of the above steps fail, contact your vendor.

2. How can I turn off the alarm beep sound when there is a hard disk failure?

Unlock the drive carrier of the failed disk. This will turn off the alarm beep sound.

3. I use a 60cm IDE cable to connect the ACS-7630, but the system shows some error messages and the hard drive can't be accessed normally. Why?

The specifications of ACS-7630 are based on ATAPI specifications. To ensure good IDE signal quality, the length of your IDE cable cannot be longer than 46 cm (18 inch).

4. I have connected the RAID controller, but it does not appear in the motherboard BIOS. Why?

Ensure that an array is initialized.

5. Why does ACS-7630 not recognize the HDDs?

There may be an HDD jumper-setting problem. Make sure all drive jumpers are set to "master"

Appendix B

Glossary

Array

See Disk Array.

Array Management Software

The body of software that provides common control and management for a disk array. Array Management Software most often executes in a disk controller or intelligent host bus adapter, but may also execute in a host computer. When it executes in a disk controller or adapter, Array Management Software is often referred to as Firmware.

Cache

Controller memory used to speed up data transfer to and from a disk.

Disk Array

A collection of disks from one or more commonly accessible disk controllers, combined with a body of Array Management Software. Array Management Software controls the disks and presents them to the array operating environment as one or more virtual disks.

Firmware

See Array Management Software.

Host Computer

Any computer system to which disks are directly attached and accessible for I/O. Mainframes, and servers, as well as workstations and personal computers, can all be considered host computers in the context of this manual, as long as they have disks attached to them.

Parity

Parity information is redundancy information calculated from actual data values. If any single piece of data is lost, the data remaining and the parity information can be used together to compute the lost data. Parity information can either be stored on a separate, dedicated drive, or be mixed with the data across all the drives in the array.

RAID (Redundant Array of Independent / Inexpensive Disks)

A disk array in which part of the storage capacity is used to store redundant information about user data stored on the remainder of the storage capacity. The redundant information enables regeneration of user data in the event that one of the array member disks or the access path to it fails. See Parity. Different RAID levels offer different data throughput speeds and fault tolerance (data redundancy). RAID 0 does not feature redundant information but is nonetheless considered a special type of RAID.

Appendix C

Specifications

Host interface	Ultra ATA 133/100/66/33
Disk interface	Ultra ATA 133/100/66/33
RAID levels supported	0, 5
Form factor	Two half height 5 ¼ inch
Dimensions	W5.75xD8.84xH3.35 (inch)
Weight	3.96 (lb)
Hot swap	Yes (Rebuilding is transparent & automatic)
Beeper alarm	Yes, built-in buzzer on board
FAN	Rated Speed: 4700RPM+/- 400RPM Noise Level: 35dB(A)



Note

Specifications are subject to change without notice.

*Appendix D***Regulatory information****FCC Statement**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of 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 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 to correct the interference by one or more of the following measures:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. Consult the dealer or an experienced radio/television technician for help.

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

Shielded interface cables, if any, must be used in order to comply with the emission limits.

**CE Mark**

This equipment is in conformity with the EMC directive.

Appendix E

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