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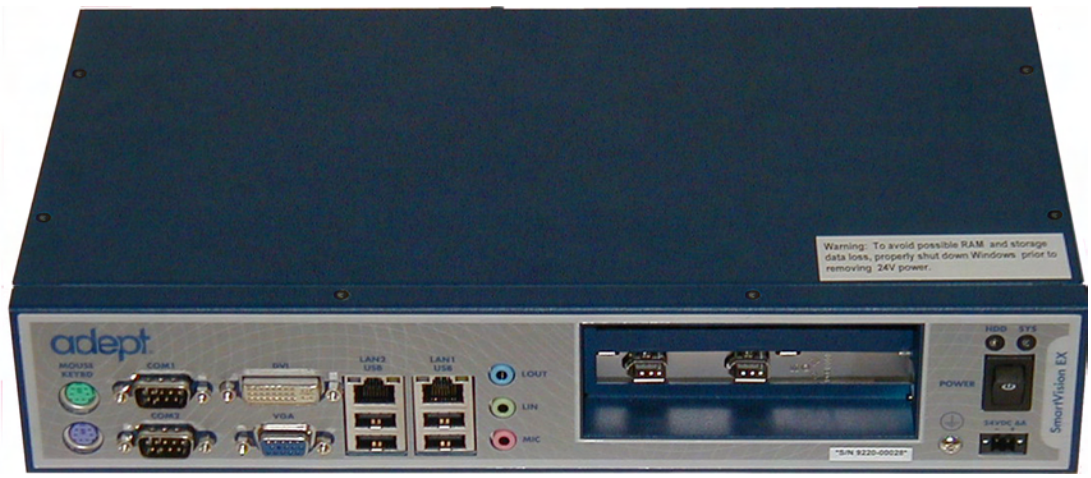
User's Guide



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Adept SmartVision EX

User's Guide



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1 Introduction

1.1 Product Description

The Adept SmartVision EX is a Windows® XP Embedded computer that is compatible with Adept's SmartController line of products.

For inspection applications, the Adept SmartVision EX unit is designed to be a "plug-and-play" vision system. Using an IEEE-1394 or a GigE camera, along with Adept's PC-based vision software, the unit is a complete industrial vision solution.

Used with a SmartController, the Adept SmartVision EX provides expanded vision processing power for vision-guided robotics or inspection.

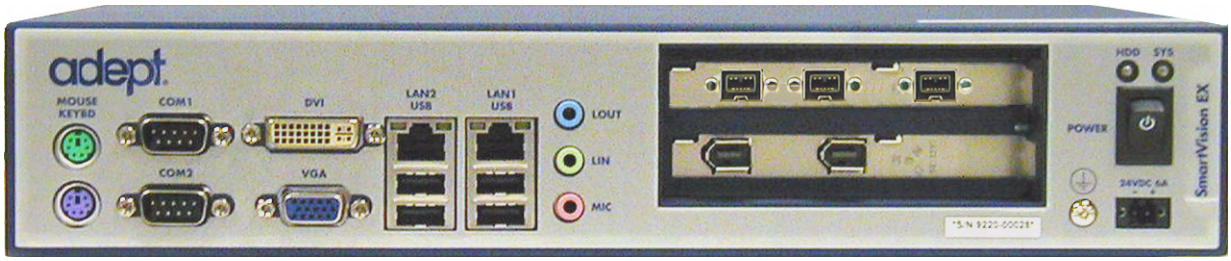


Figure 1-1. The Adept SmartVision EX, with 1394b and 1394a Options

Features

The Adept SmartVision EX provides the following features:

- Compatibility with Adept's SmartController line of products
- Intel PC platform, with Core 2 Duo processors at 2.0 GHz or better
- Windows® XP Embedded (XPe)
- Standard Dual Gigabit LAN
- Standard RS-232 interface
- Two PCIe slots, to support IEEE-1394a, IEEE-1394b, GigE, and I/O cards
- Support for a keyboard, monitor, and mouse, for standalone operation

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What Comes with an Adept SmartVision EX?

Hardware

The Adept SmartVision EX comes with the chassis, shown in **Figure 1-1**, and any expansion slot cards that you order. The unit shares the same footprint as the Adept SmartController. The standard Adept SmartVision EX includes:

- Intel® Core Duo, dual 64-bit cores, 2.16 GHz
- 2 GB DDR2 memory
- 80 GB hard drive (2.5 in.)

  The hard drive is partitioned into a C: drive and a D: drive. By default, the C: drive uses a file-based write filter, to protect the Windows operating system and Adept ACE software. Adept recommends that you leave this write filter enabled for C: in normal use.

  Because the OS and Adept ACE software are on C:, you should be very cautious about using C: for any other purpose, particularly for other applications.
- All of the connectors listed in **Table 4-1, "Adept SmartVision EX Connectors and Indicators," on page 31**.
- A USB license dongle, which enables licenses for one of the following:
  - AdeptSight software, 2 camera support
  - ACE PackXpert, 1 controller support
  - ACE PackXpert with AdeptSight software, 2 camera and 1 controller support

  and
  - Any additional camera or controller licenses that you purchased

  An Adept SmartVision EX can support a total of four cameras and four controllers.

  NOTE: If you are going to use Adept SmartVision EX with AdeptSight, but without ACE PackXpert, the Adept SmartController needs to have a motion license.
- Panel-mount brackets
- Stack-mount brackets

Software

The following software is pre-loaded on the hard drive:

- Windows® XP Embedded
- Adept ACE
- AdeptSight 3 (Adept ACE-based vision software)
- Drivers for Basler cameras (IEEE 1394 and GigE) and the PCIe I/O card

The Adept SmartVision EX is designed to run Adept ACE software. Adept does not support applications other than Adept ACE.

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Options

- Any PCIe cards that you order are already installed. The available options are covered in "Expansion Slot Options" on page 37. There are two PCIe expansion slots.

  An HPDB50-DB50 I/O cable, 2 meters long, is supplied with the PCIe I/O card.

- Licenses, enabled on the USB license dongle
- Rack- or desktop-mounting brackets (see "Mounting Options" section on page 21)

What Doesn't Come with an Adept SmartVision EX?

- 24 VDC power supply to power the Adept SmartVision EX (see "24 VDC Power Specifications" section on page 26)

  If you are using the Adept SmartVision EX with a SmartController, you can use 24 VDC power from the SmartController to power the Adept SmartVision EX. See "Connecting an Adept SmartVision EX to a SmartController" section on page 29.

- Cameras and camera cables
- I/O cables, other than the cable supplied with the PCIe I/O card
- Keyboard, mouse, and monitor
- DB50 terminal block
- If power interruption is a concern, a UPS is recommended. Contact Adept Customer Service for more information.

1.2 Manufacturer's Declaration

The Manufacturer's Declaration of Incorporation and Conformity for the Adept SmartVision EX system can be found on the Adept website, under the Support section. The URL for the folder is:

ftp://ftp1.adept.com/Download-Library/Manufacturer-Declarations/

Each Manufacturer's Declaration is supplied in PDF format and stored on the website in a ZIP archive. To access the PDF document:

1. Click on the appropriate .zip file. You are prompted to Open or Save the file.
2. Click Open to open the file and display the archive contents.
3. Double-click on a .pdf file to open it.

1.3 How Can I Get Help?

For details on getting assistance with your Adept software or hardware, you can access the following information sources on the Adept corporate website:

- For Contact information: http://www.adept.com/contact/americas
- For Product Support information: http://www.adept.com/support/service-and-support/main
- For further information about Adept Technology, Inc.: http://www.adept.com

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Related Manuals

This manual covers the installation and startup of an Adept SmartVision EX system. There are additional manuals that cover programming the system, reconfiguring installed components, and adding other optional components. The following manuals (available on the Adept Document Library CD-ROM provided with each system) provide information on advanced configurations and system specifications.

Table 1-1. Related Manuals

Manual Title	Description
Adept SmartController User's Guide	Contains complete information on the installation and operation of the Adept SmartController and the optional sDIO product.
Adept ACE User's Guide	Describes the Adept ACE environment and use with an Adept control system.
AdeptSight v3.x User's Guide	Describes the installation, programming, and use of the AdeptSight vision tools.
Instructions for Adept Utility Programs	Describes the utility programs used for advanced system configurations, system upgrades, file copying, and other system configuration procedures.
V+ Operating System User's Guide	Describes the V+ operating system, including disk file operations, monitor commands, and monitor command programs.
V+ Language User's Guide	Describes the V+ language and programming of an Adept control system.

Adept Document Library

The Adept Document Library (ADL) contains documentation for Adept products. You can access the ADL either from the CD-ROM provided with each system, or on-line as follows:

- Select **Support > Document Library** from the menu bar on the Adept website Home page

  or

- Type the following URL into your web browser:

  http://www.adept.com/Main/KE/DATA/adept_search.htm

To locate information on a specific topic, use the Document Library search engine on the ADL Search page. To view a list of available document titles, select an option from one of the listed product categories.

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Safety 2

2.1 Warnings, Cautions, and Notes

There are six levels of special alert notation used in Adept manuals. In descending order of importance, they are:



DANGER: This indicates an imminently hazardous electrical situation which, if not avoided, will result in death or serious injury.



DANGER: This indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING: This indicates a potentially hazardous electrical situation which, if not avoided, could result in injury or major damage to the equipment.



WARNING: This indicates a potentially hazardous situation which, if not avoided, could result in injury or major damage to the equipment.



CAUTION: This indicates a situation which, if not avoided, could result in damage to the equipment.

NOTE: This provides supplementary information, emphasizes a point or procedure, or gives a tip for easier operation.

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2.2 Precautions and Required Safeguards

This manual must be read by all personnel who install, operate, or maintain Adept systems, or who work within or near the workcell.

Reading and Training for Users and Operators

Adept systems can include computer-controlled mechanisms that are capable of moving at high speeds and exerting considerable force. Like all robot and motion systems, and most industrial equipment, they must be treated with respect by the user and the operator.

This manual should be read by all personnel who operate or maintain Adept systems, or who work within or near the workcell.

The installation and use of Adept products must comply with all safety instructions and warnings in this manual. Installation and use must also comply with all applicable local and national requirements and safety standards.

The equipment, as delivered by Adept, complies with the relevant and fundamental safety and health requirements defined by the EC Machinery Directive, Annex I. Refer to **"Manufacturer's Declaration" section on page 15**. The machine must not be put into operation until all the machinery into which it is incorporated has been declared to be in compliance with the provisions of the effective versions of the directives. This includes all supplementary equipment and protective devices.

We recommend that you read the *American National Standard for Industrial Robot Systems - Safety Requirements*, published by the Robotic Industries Association (RIA) in conjunction with the American National Standards Institute. The publication, ANSI/RIA R15.06, contains guidelines for robot system installation, safeguarding, maintenance, testing, startup, and operator training.

We also recommend that you read the International Standard IEC 204 or the European Standard EN 60204, *Safety of machinery – Electrical equipment of machines*, and ISO 10218 (EN 775), *Manipulating Industrial Robots – Safety,* particularly if the country of use requires a CE-certified installation.

This manual assumes that the user has attended an Adept training course and has a basic working knowledge of the system. The user should provide the necessary additional training for all personnel who will be working with the system.

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System Safeguards

Safeguards must be an integral part of robot or motion workcell design, installation, operator training, and operating procedures.

Computer Controlled Robots and Motion Devices



DANGER: Entering the workcell when the High Power light is on can result in severe injury.

Adept systems are computer controlled, and the program that is currently running the robot or motion device may cause it to move at times or along paths you may not anticipate. When the High Power light on the front panel is illuminated, do not enter the workcell, because the robot or motion device might move unexpectedly.

Other Computer-Controlled Devices

In addition, Adept systems can be programmed to control equipment or devices other than the robot or main motion device. The program controlling these other devices may cause them to operate unexpectedly. Make sure that safeguards are in place to prevent personnel from entering the workcell when a program is running.

Adept Technology highly recommends the use of additional safety features, such as light curtains, safety gates, or safety floor mats to prevent entry to the workcell while high power is enabled. These devices can be connected using the emergency stop circuitry.

Standards Compliance

The Adept SmartVision EX is intended for use with other equipment and is considered a subassembly rather than a complete piece of equipment on its own.

If the Adept SmartVision EX is used with equipment other than the equipment with which it was evaluated for standards compliance, you might not be in compliance with those standards.

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3 Installation

The Adept SmartVision EX should be shipped and stored in the Adept-supplied packaging, which is designed to prevent damage from normal shock and vibration. You should protect the package from excessive shock and vibration. For environmental specifications, refer to **"Environmental Specifications" section on page 65**.

3.1 Before Unpacking

Carefully inspect all packaging for evidence of damage during transit. If any damage is indicated, request that the carrier's agent be present at the time the package is opened.

Inspecting

Compare the actual items received (not just the packing slip) with your equipment purchase order, and verify that all items are present and that the shipment is correct. Inspect each item for external damage as it is unpacked. Contact Adept immediately if any damage is evident. See **"How Can I Get Help?" section on page 15**.

Retain all containers and packaging materials. These items may be needed in the future to settle a damage claim.

Remove the Adept SmartVision EX. Mount it near the robot.

3.2 Mounting the Adept SmartVision EX

Space Around the Chassis

When the Adept SmartVision EX is installed, you must allow 10 mm at the back of the unit and 13 mm on the sides of the unit for proper air circulation.

Mounting Options

The following mounting options are available for the Adept SmartVision EX:

- Rack
- Panel
- Desktop
- Stack (one unit placed on top of another)

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The following sections cover each mounting option.

Rack Mounting

To rack-mount the Adept SmartVision EX in a standard 19-inch equipment rack, install the optional mounting brackets on the side, as shown in the following figure. These brackets must be ordered separately; they do not come with the Adept SmartVision EX.

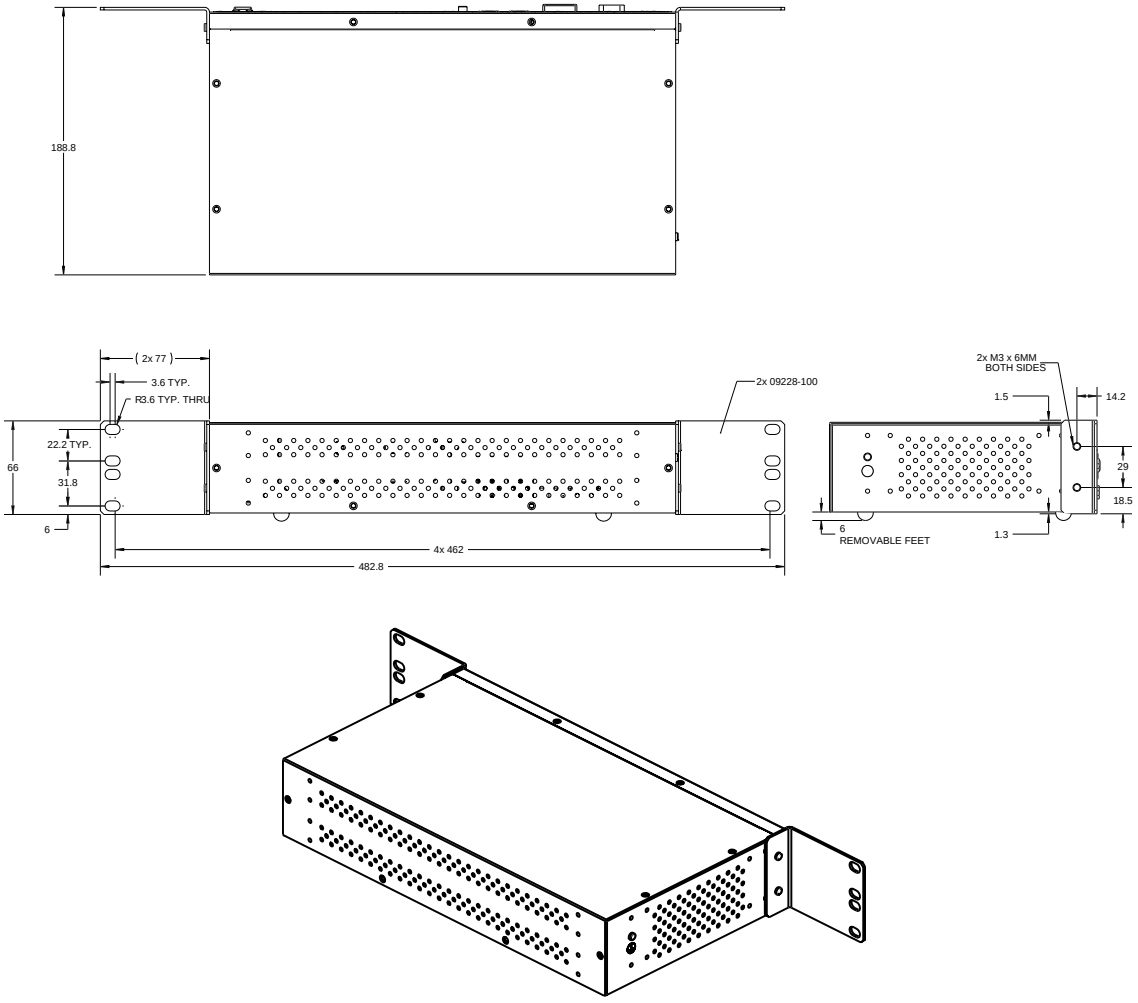


Figure 3-1. Rack-Mounting the Adept SmartVision EX

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Panel Mounting

To panel-mount the Adept SmartVision EX, install two brackets on each side at the rear of the unit, as shown in the following figure. Use the brackets and screws from the bracket kit.

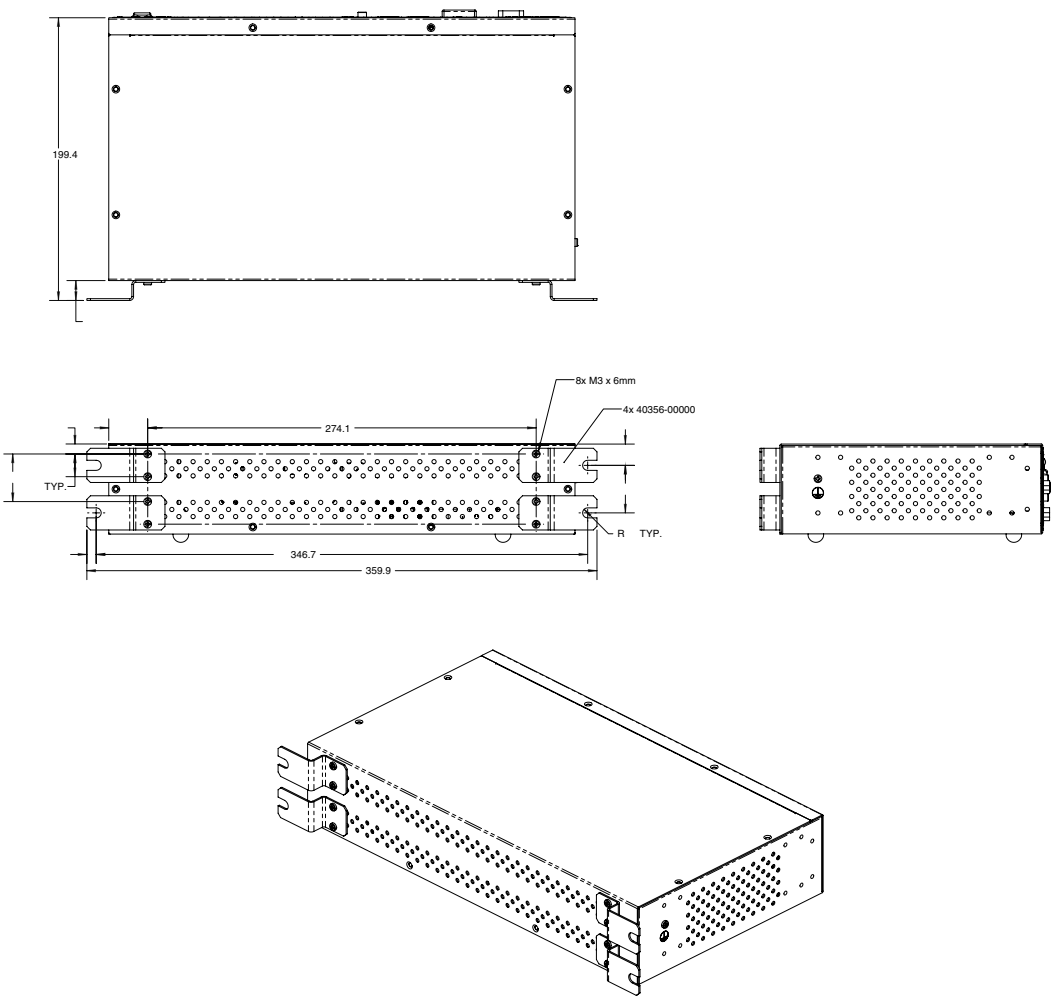


Figure 3-2. Panel-Mounting the Adept SmartVision EX

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Desktop Mounting

To table-mount the Adept SmartVision EX, install two brackets on each side near the bottom of the unit, as shown in the following figure. These brackets must be ordered separately; they do not come with the Adept SmartVision EX.

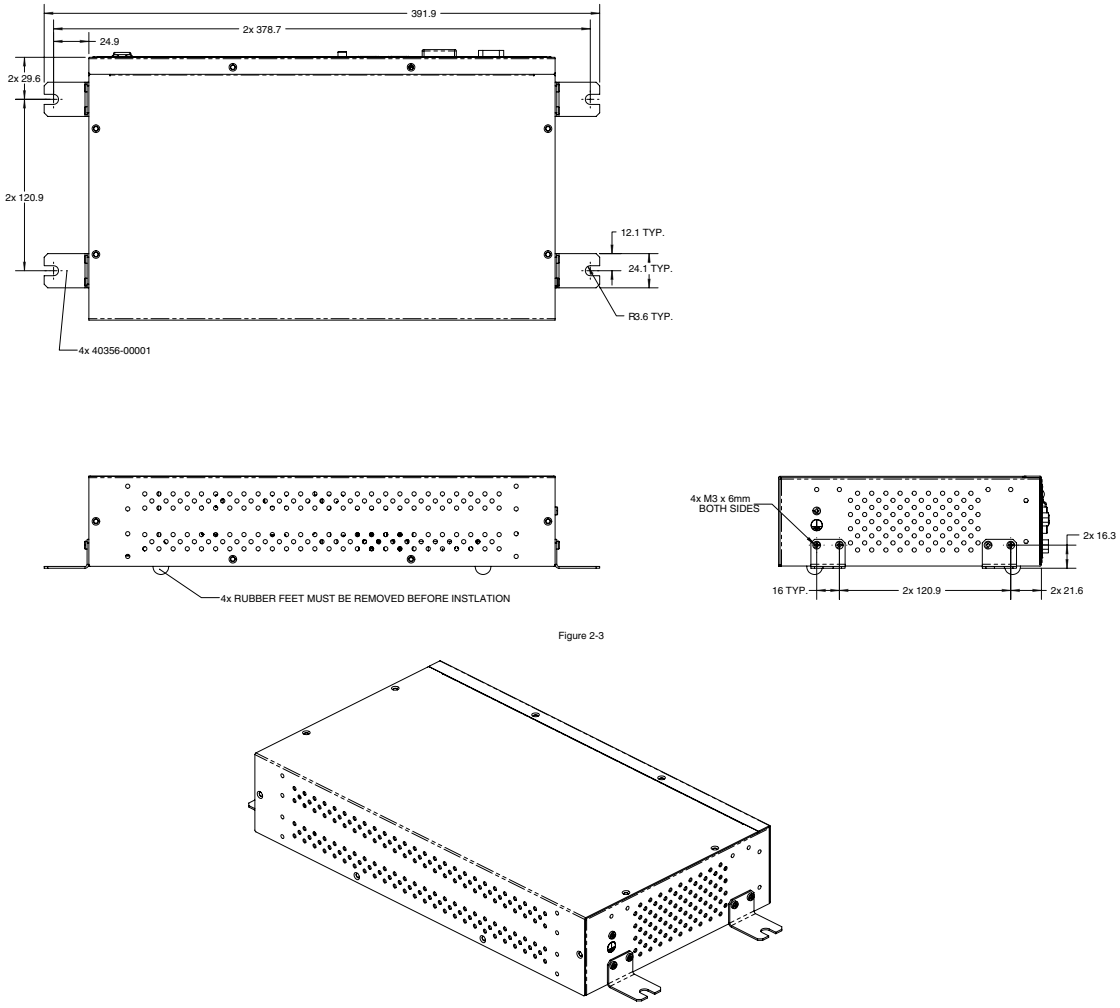


Figure 3-3. Table-Mounting the Adept SmartVision EX

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Stack Mounting

To stack-mount the Adept SmartVision EX, install two brackets on each side of the units, as shown in the following figure. Use the brackets and screws from the bracket kit.

The Adept SmartVision EX, Adept SmartController, and Adept sDIO all share the same footprint, and can be stacked in this way.

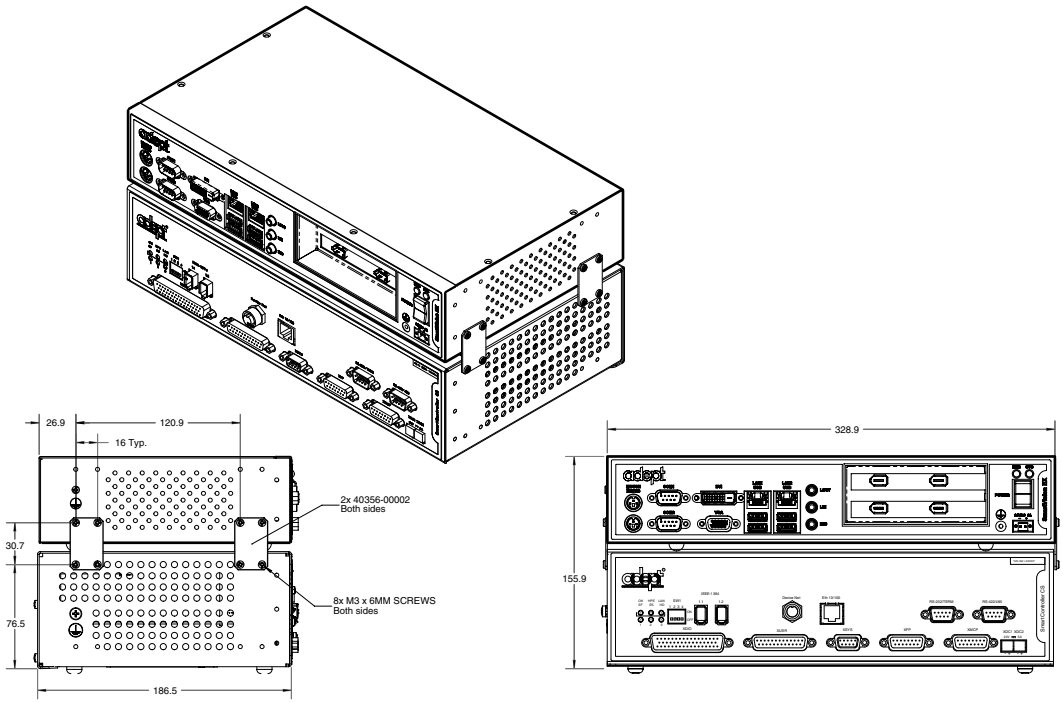


Figure 3-4. Stack-Mounting the Adept SmartVision EX and SmartController CS

3.3 Connecting Power

The Adept SmartVision EX requires filtered 24 VDC power.

> **NOTE:** *You must provide your own power supply.* Make sure the power cables and power supply conform to the specifications in the following table.

Refer also to **"Connecting an Adept SmartVision EX to a SmartController" on page 29**.

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24 VDC Power Specifications

Table 3-1. Specifications for 24 VDC User-Supplied Power Supply

Customer-Supplied Power Supply	24 VDC (-10%, +5%), 150 W (6 A)
Circuit Protection	Not more than 8 A (below the amperage rating of the cable used)
Power Cabling	1.5 - 1.85 mm^2 (16-14 AWG), full-cover, braided shield cable, maximum length 10 meters
Shield Termination	Braided shield connected to the marked frame ground screw on the front of the Adept SmartVision EX (near the XDC connector). On the other end of the cable, the shield should be connected to the power supply chassis.



CAUTION: Make sure you select a 24 VDC power supply that meets the specifications in the preceding table. Using an underrated supply can cause system problems and prevent your equipment from operating correctly. See the following table for recommended power supplies.

Table 3-2. Recommended 24 VDC Power Supplies

Vendor Name	Model	Ratings
XP Power	JPM160PS24	24 VDC, 6.7 A, 160 W
Mean Well	SP-150-24	24 VDC, 6.3 A, 150 W
Astrodyne	ASM150-24	24 VDC, 6.66 A, 150 W

NOTE: The power requirements for the user-supplied power supply will vary depending on the configuration of the Adept SmartVision EX and connected devices. A minimum configuration requires 3.0 A at 24 VDC. However, a 24 V, 6 A power supply is recommended to allow for additional current draw from connected devices, such as external IEEE 1394 devices and digital I/O loads.

24 VDC Power Cabling

In order to maintain compliance with EN standards, DC power must be delivered over a shielded cable, with the shield connected to the frame ground at both ends of the cable, as shown in the following two figures. Conductors should be 1.5 mm^2 - 1.85 mm^2 (16 to 14 AWG) in size. The maximum length for the 24 VDC cable is 10 meters.

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Installing 24 VDC Connectors

Use the Adept-supplied connectors to connect the user-supplied 24 VDC power supply to the Adept SmartVision EX.

1. Locate the 24 VDC connector that is shipped with the Adept SmartVision EX. See the following figure.

   Use 14 or 16 gauge wire to connect the 24 VDC power supply to the Adept SmartVision EX.

2. Strip 7 mm of insulation from the end of the wire that connects to the positive output of the 24 VDC supply.
3. Insert the stripped end of the wire into the opening on the right side of the connector.
4. Repeat this process to connect the wire from the negative side of the power supply to the left side of the connector.
5. Using a small, flat-blade screwdriver (2.5 mm), tighten the screw clamps on the connector.
6. Visually inspect the connection to ensure that the clamp has closed on the wire, not on the insulation.
7. Gently pull on the wire to confirm that it is securely attached to the connector.
8. Connect the braided shield to the ground screw on the front panel. A ring lug can be used, as shown in the following figure.

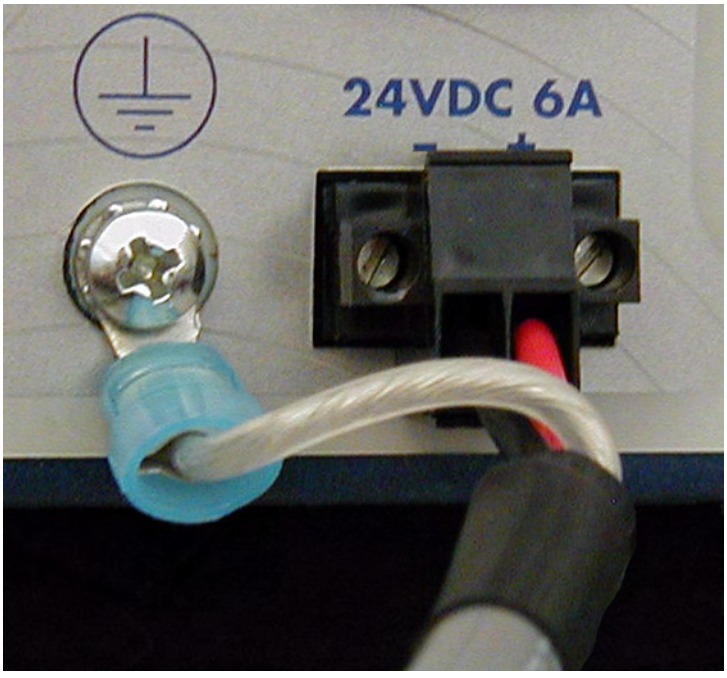


Figure 3-5. 24 VDC Connector, with Shield Attached to Ground

NOTE: Although no damage will occur, the Adept SmartVision EX will not turn on if the DC polarities of the VDC connectors are reversed.

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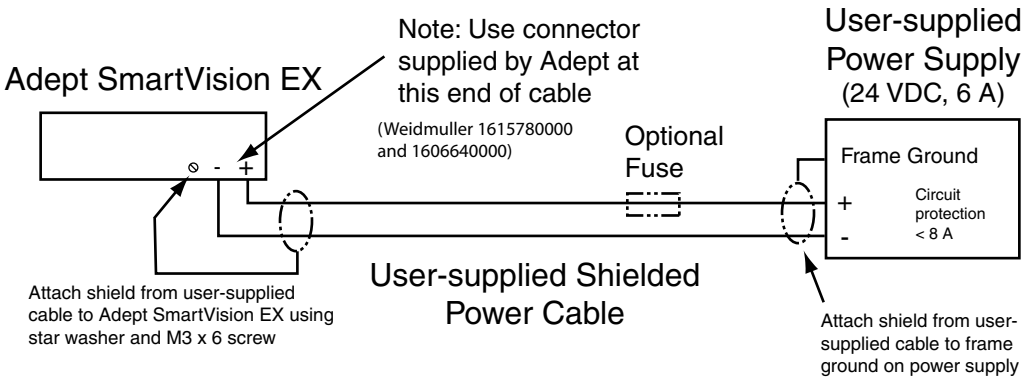


Figure 3-6. User-Supplied Power Cable

Chassis Grounding

The Adept SmartVision EX is equipped with a grounding point. See the following figure. Adept recommends connecting a ground wire from the ground point on the Adept SmartVision EX to earth ground, and that all other interconnected Adept components share the same electrical ground potential. The ground wire must meet all local regulations. Additional grounding information for other Adept products is provided in the documentation for those products.

NOTE: The maximum length for the ground wire for the Adept SmartVision EX is 3 meters.

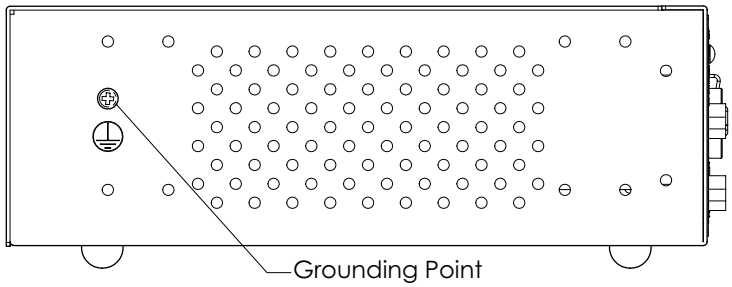


Figure 3-7. Chassis Grounding Point

In Europe, the mounting and all terminations of the Adept SmartVision EX must be performed in accordance with European Standard EN 60204, *Safety of machinery – Electrical equipment of machines*, to maintain compliance.

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3.4 Connecting an Adept SmartVision EX to a SmartController

The 24 VDC can be obtained from a SmartController if you are connecting the Adept SmartVision EX to one. The total current, used by both the Adept SmartController and the Adept SmartVision EX, as well as any peripherals attached to them, must stay within the limits of your 24 VDC power supply.

The 24 VDC power cable is user-supplied.

1. Connect a 24 VDC cable from XDC1 or XDC2 on the controller (whichever is not used) to the 24 VDC plug on the Adept SmartVision EX.
2. Follow the instructions in **"Installing 24 VDC Connectors" on page 27** for grounding the power cable shielding to both the controller and the Adept SmartVision EX.

   If your system has sDIO or sMI6, these need to be placed between the Adept SmartController and the Adept SmartVision EX unit, so the power can be daisy-chained. The Adept SmartVision EX has only one 24 VDC plug. The other units have two.

   If you are connecting peripherals to the Adept SmartVision EX, you may need to run a dedicated 24 VDC cable to the Adept SmartVision EX, rather than tapping power from the controller. Make sure you are not exceeding the current capacity of the controller 24 VDC plug or your power supply.

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4 Connectors and Indicators

The Adept SmartVision EX, shown in the following figure, can connect to many different peripherals and other Adept products. This section describes the connectors and indicators available.

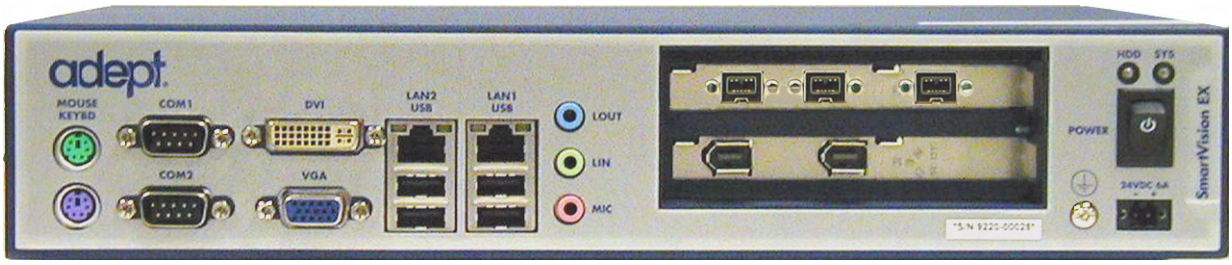


Figure 4-1. Adept SmartVision EX Connectors

The following table summarizes the Adept SmartVision EX connectors:

Table 4-1. Adept SmartVision EX Connectors and Indicators

Connector or Indicator	Description
	Connect the green PS/2 connector to a mouse for the Adept SmartVision EX. See "Keyboard and Mouse Ports" section on page 34.
	Connect the purple PS/2 connector to a keyboard for the Adept SmartVision EX. See "Keyboard and Mouse Ports" section on page 34.
	Connect the COM1 and COM2 ports to communicate with external devices at baud rates of up to 115 Kbaud. These support RS-232. See "Serial I/O Connectors" section on page 34.
	

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Table 4-1. Adept SmartVision EX Connectors and Indicators

Connector or Indicator	Description
	Connect the Adept SmartVision EX DVI cable to a monitor. See "Connecting a Monitor" section on page 35.
	Connect the Adept SmartVision EX VGA cable to the VGA connector on a monitor. See "Connecting a Monitor" section on page 35.
	Use a LAN connector for connecting the Adept SmartVision EX to a SmartController or a network. See "Connecting to a Network" section on page 35. Do not connect the Adept SmartVision EX to the internet.
	Use the USB connectors for devices that typically remain connected, such as printers and keyboards.
	Use the blue line-out connector to attach headphones and most speakers with integrated amplifiers. This connector, while functional, currently has no application to Adept systems.
	Use the green line-in connector to attach a record/playback device such as a CD-ROM. This connector, while functional, currently has no application to Adept systems.

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Table 4-1. Adept SmartVision EX Connectors and Indicators

Connector or Indicator	Description
	Use the pink connector to attach a personal computer microphone. This connector, while functional, currently has no application to Adept systems.
	The HDD indicator monitors the hard drive. The indicator light is illuminated when the hard drive is being accessed.
	The System Power (SYS) is illuminated whenever the Adept SmartVision EX is powered on.
	The power switch is a toggle switch. Press the button once to enable power. Pressing this switch while the power is on shuts down Windows and powers off the Adept SmartVision EX. By default, the Adept SmartVision EX automatically powers on when 24 volts is applied.
	The front panel ground point can be used to terminate the shield when a shielded 24 VDC power cable is used. See Figure 3-5 on page 27.
	24 VDC jack. The user-supplied 24 VDC power supply connects here. The mating connector is supplied with the Adept SmartVision EX unit.

The ports available in the expansion slots will vary, depending on what you order.

Table 4-2. Adept SmartVision EX Expansion Slots

Expansion Slots	Description
	The Adept SmartVision EX supports multiple peripherals via two expansion slots. Refer to Chapter 5 for details.

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4.1 Keyboard and Mouse Ports

The PS/2 connectors (shown in the following figure) allow you to use a PC-compatible keyboard and mouse with the Adept SmartVision EX. The Adept SmartVision EX accepts any IBM AT-compatible keyboard, including 84-key standard keyboards and 101-key enhanced keyboards. Use the green connector for the mouse and the purple connector for the keyboard.

NOTE: You can also connect a USB keyboard and mouse, using one of the USB ports.



Figure 4-2. PS/2 Connectors

4.2 Serial I/O Connectors

The Adept SmartVision EX has two serial ports that you can use to communicate with external devices at baud rates of up to 115 Kbaud.

NOTE: When you are using RS-232 communications, the length of the serial cable should not exceed 15 meters (50 feet).

Settings and Pinouts for COM1/COM2

If you need to make a cable for communicating with COM1 or COM2, the following table shows the pinouts and signal information for these ports.

Table 4-3. COM1/COM2 (RS-232) Pinouts

Pin#	Signal
1	DCD, data carrier detect
2	RXD, received data
3	TXD, transmitted data
4	DTR, data terminal ready
5	SG, signal ground
6	DSR, data set ready
7	RTS, request to send
8	CTS, clear to send
9	RI, ring indicator

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4.3 Connecting a Monitor

To connect a monitor with a VGA connector or a DVI connector:

- Connect the monitor to the VGA (blue) connector on the Adept SmartVision EX

  or

- Connect the monitor to the DVI (white) connector on the Adept SmartVision EX.

4.4 Connecting to a Network

To attach your Adept SmartVision EX to a SmartController, network, or broadband device, connect an Ethernet cable between the device and one of the LAN ports on the Adept SmartVision EX. The network cable will click into place when it is fully inserted.



CAUTION: Do not connect the Adept SmartVision EX unit to the internet.

Adept recommends that you use Category 5 wiring and connectors for your network. If you must use Category 3 wiring, limit the network speed to 10 Mbps to ensure reliable operation.

NOTE: Do not plug a telephone cable into the network connector.

4.5 Connecting USB Peripherals

To attach a USB peripheral, plug the peripheral cable into one of the four USB jacks on the Adept SmartVision EX.

4.6 Sound Connections

The connectors for sound (LOUT, LIN, and MIC), while functional, currently have no application to Adept systems.

4.7 Expansion Slots

The Adept SmartVision EX provides two slots for PCIe cards.

Currently-supported options for these slots are:

- IEEE-1394a - two ports/card
- IEEE-1394b - three ports/card
- GigE - one port/card
- 50-pin I/O card - one port/card

Refer to **"Expansion Slot Options" on page 37** for more details on PCIe cards.

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4.8 24 VDC Power

Power Switch

The front panel power switch turns on or off 24 V power to the Adept SmartVision EX. Pressing this switch while the power is on, shuts down Windows and powers off the Adept SmartVision EX.

Ground Connector

The front panel ground point can be used to terminate the shield when a shielded 24 VDC power cable is used. Refer to **Figure 3-6 on page 28** for more details.

The left side of the Adept SmartVision EX is also equipped with a grounding point. Refer to **"Chassis Grounding" on page 28** for more details.

24 VDC Connector

The connector from the user-supplied 24 V power supply plugs in here. Refer to **"Connecting Power" section on page 25** for more details.

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5 Options

5.1 License Options

The following license bundles can be enabled on the Adept USB license dongle:

- ACE PackXpert (includes support for 1 controller)
- AdeptSight (includes support for 2 cameras)
- ACE PackXpert with AdeptSight (includes support for 1 controller and 2 cameras)

Other licenses can be purchased to increase the number of cameras and controllers supported. The Adept SmartVision EX can support a total of four cameras and four controllers.

> **NOTE:** If you are going to use Adept SmartVision EX with AdeptSight, but without ACE PackXpert, the Adept SmartController needs to have a motion license.

5.2 Mounting Options

- Rack-mounting brackets
- Desk-mounting brackets

  (Brackets for panel-mounting and stack-mounting are included in the bracket kit.)

5.3 Expansion Slot Options

The Adept SmartVision EX has two expansion slots, which support the following PCIe card options:

- Basler 1394a[1] card

  2 ports per card
- Basler 1394b card

  3 ports per card
- GigE card (for Basler GigE camera only)

  1 port per card
- 50-pin I/O card

  1 port per card

[1] IEEE 1394a and IEEE 1394b standards are not compatible.

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5.4 PCIe Camera Cards

Camera Speed (throughput)

NOTE: The Adept SmartVision EX can support a total of four cameras.

GigE

A standalone Adept SmartVision EX (not connected to a SmartController or network) can have up to four Ethernet ports: two are built-in, and two are possible with two GigE expansion cards. The Adept SmartVision EX unit makes no distinction between the different Ethernet ports. Four ports will support up to four cameras at the full GigE speed of 1000 Mbit/s each.

An Adept SmartVision EX that is connected to a SmartController or network will have one built-in Ethernet port available, and one more for each GigE expansion card in the unit.

If a switch is used to add more cameras, the 1000 Mbit/s will be shared between all cameras being serviced by each port. Two cameras on one port can run at a maximum speed of 500 Mbit/s each, and so on.

1394b

Each 1394b expansion card has three ports. The total capacity of each card is 800 Mbit/s, which is divided between the number of cameras using that card. The fastest throughput per camera is obtained with one camera per card, yielding the full 800 Mbit/s for each camera. Two cameras on one card can operate at 400 Mbit/s each, and so on.

Adding a second 1394b card adds another 800 Mbit/s of bandwidth, which can be divided between the cameras connected to that card.

1394a

Each 1394a expansion card has two ports. The total capacity of each card is 400 Mbit/s, which is divided between the number of cameras using that card. The fastest throughput is obtained with one camera per card, yielding the full 400 Mbit/s for each camera. Two cameras on one card can operate at a maximum speed of 200 Mbit/s each.

Adding a second 1394a card adds another 400 Mbit/s of bandwidth, which can be divided between the cameras connected to that card.

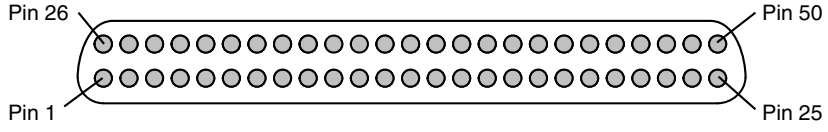
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5.5 PCIe I/O Card Connections

Each PCIe I/O card has a single, 50-pin port. The card part number is 09228-040.

Table 5-1. I/O Card Pin Assignments

Pin	Signal	Pin	Signal
1	VDD Input (fly-wheel diode)	26	VDD Input (fly-wheel diode)
2	Common ground or common power for inputs 1009 - 1016	27	Isolated power output 5 V (Do not use)
3		28	Common ground or common power for inputs 1009 - 1016
4		29	
5	Output 8	30	Output 15
6	Output 7	31	Output 16
7	Output 6	32	Output 13
8	Output 5	33	Output 14
9	Output 4	34	Output 11
10	Output 3	35	Output 12
11	Output 2	36	Output 9
12	Output 1	37	Output 10
13	Input 1004 High	38	Input 1008 High
14	Input 1004 Low	39	Input 1008 Low
15	Input 1003 High	40	Input 1007 High
16	Input 1003 Low	41	Input 1007 Low
17	Input 1002 High	42	Input 1006 High
18	Input 1002 Low	43	Input 1006 Low
19	Input 1001 High	44	Input 1005 High
20	Input 1001 Low	45	Input 1005 Low
21	Input 1012	46	Input 1016
22	Input 1011	47	Input 1015
23	Input 1010	48	Input 1014
24	Input 1009	49	Input 1013
25	Output Gnd	50	Output Gnd



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NOTE: The single port on the card is an HPDB50. A 2-meter HPDB50 - DB50 cable, for connecting a terminal block to the I/O card, is supplied with the I/O card (09448-020).

Optional I/O Products

These optional products are also available for use with digital I/O:

- **Terminal Block**, with DB50 jack and individual terminals for user wiring. DB50 jack connects to the HPDB50 port on the I/O card in the Adept SmartVision EX or XDIO port on a SmartController. (09438-000)
- **DB50 - DB50 Extension Cable**, 5 meters long. (09447-050)

Input Signals

The 16 inputs are arranged in two groups. Inputs 1001 through 1008 are independently isolated and differential. Inputs 1009 through 1016 are grouped into a bank, and all share a single common source/sink line.

The inputs are accessed through direct connection to the 50-pin connector (see **Table 5-1 on page 39**), or through the optional terminal block.

Input Specifications

The following table applies to all inputs, 1001 - 1016, on the I/O card.

Table 5-2. I/O Card Input Specifications

Operational voltage range	0 to 30 VDC
“OFF” state voltage range	0 to 3 VDC
“ON” state voltage range	10 to 30 VDC
Typical threshold voltage	V_{in} = 8 VDC
Operational current range	0 to 12.5 mA
“OFF” state current range	0 to 1.25 mA
“ON” state current range	4.2 to 12.5 mA
Typical threshold current	3.3 mA
Impedance (V_{in}/I_{in})	2.4 KΩ minimum

NOTE: The input current specifications are provided for reference. Voltage sources are typically used to drive the inputs.

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In the following figure, Example 1 shows inputs 1001 to 1003 with a negative common, Example 2 shows inputs 1004 to 1006 with a positive common, and Example 3 shows inputs 1007 and 1008 with independent power supplies (no common).

NOTE: These are examples. Either method can be used on any input.

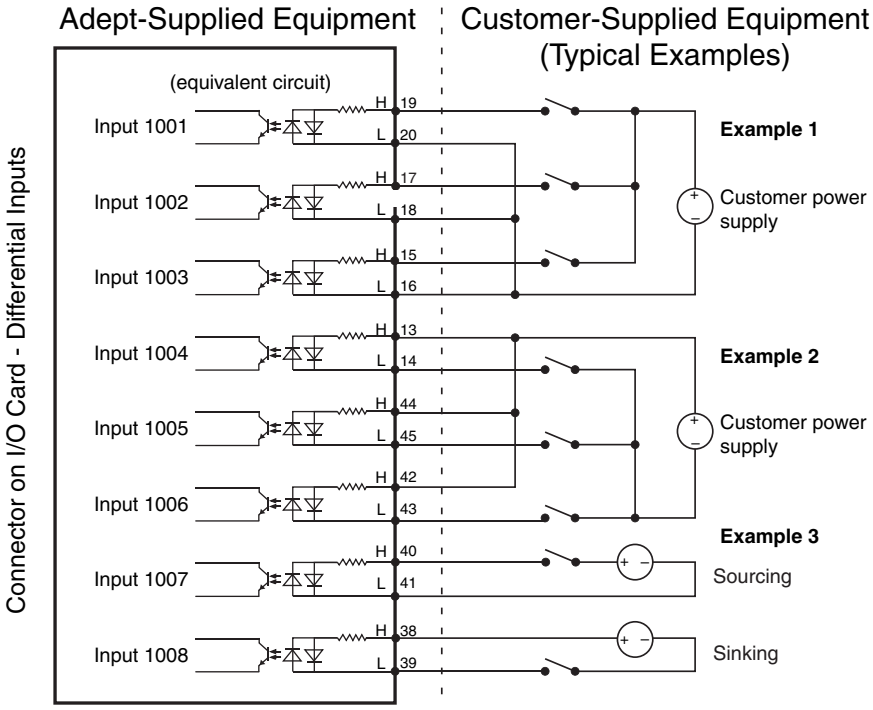


Figure 5-1. Differential Digital Inputs, 1001 through 1008

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Typical Input Wiring Example

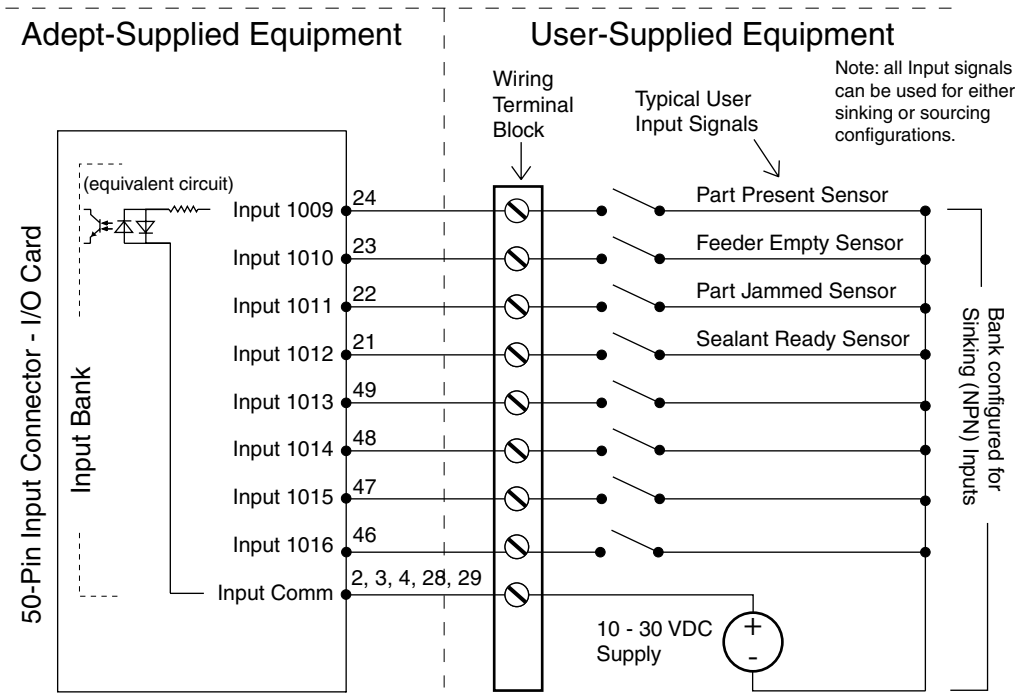


Figure 5-2. Typical User Wiring for Sinking Input Signals 1009 - 1016

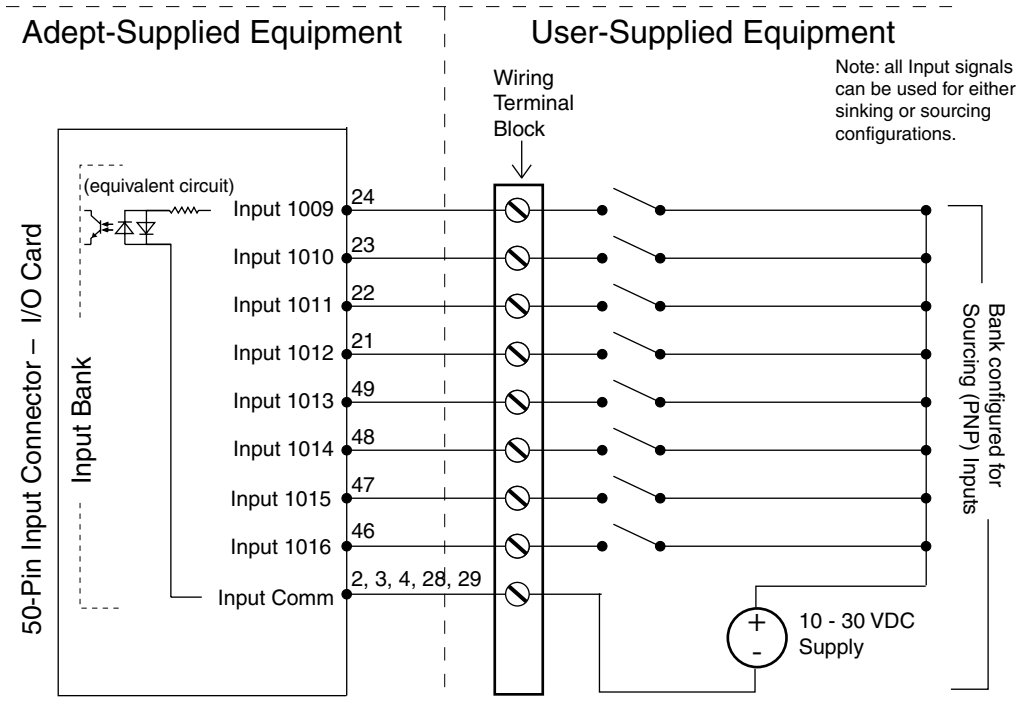


Figure 5-3. Typical User Wiring for Sourcing Input Signals 1009 - 1016

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Output Signals

The sixteen digital outputs (1 - 16) share a common, low side (sinking) driver IC. The driver is designed to supply any kind of load with one side connected to 10 to 30 VDC. The driver does not include short-circuit protection and the user must take care to prevent shorts. An overload may damage the driver circuit. Internal "fly-wheel" diodes are included for driving inductive loads. The VDD power pin must be connected when driving inductive loads.

The outputs are accessed through a direct connection to the 50-pin connector, or through the optional terminal block.

Output Specifications

Table 5-3. I/O Card Output Specifications

Parameter	Value
Power supply voltage range	10 to 30 VDC
Operational current range, per channel	$I_{out} \leq$ 62.5 mA, all channels active $I_{out} \leq$ 500 mA, one channel active

Typical Output Wiring Example

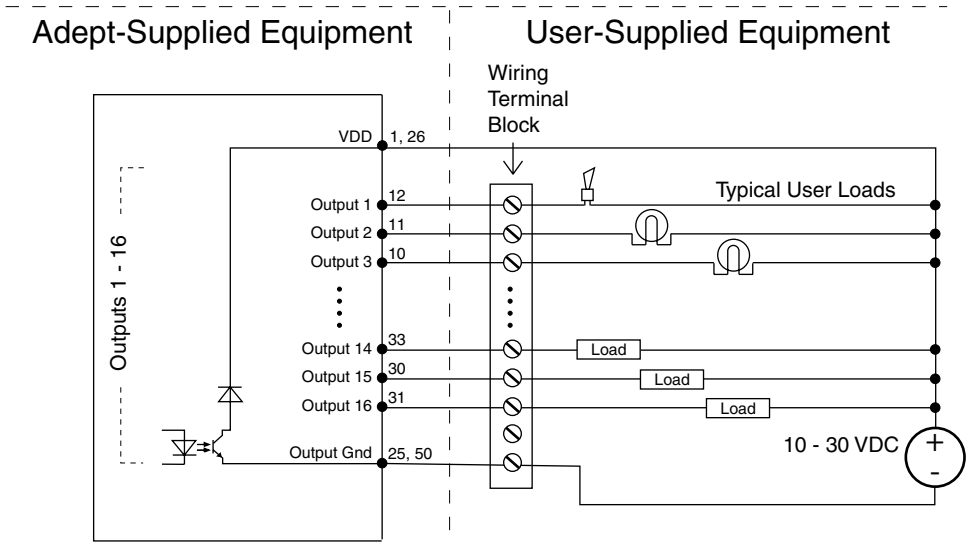


Figure 5-4. Typical User Wiring for Output Signals

5.6 Installing PCIe Cards

The Adept SmartVision EX provides two expansion slots for PCIe cards. This section gives instructions for installing a PCIe card.

1. Remove the top cover of the Adept SmartVision EX.
2. Unplug the internal 24 V plug.

   This makes installation of the PCIe cards easier.

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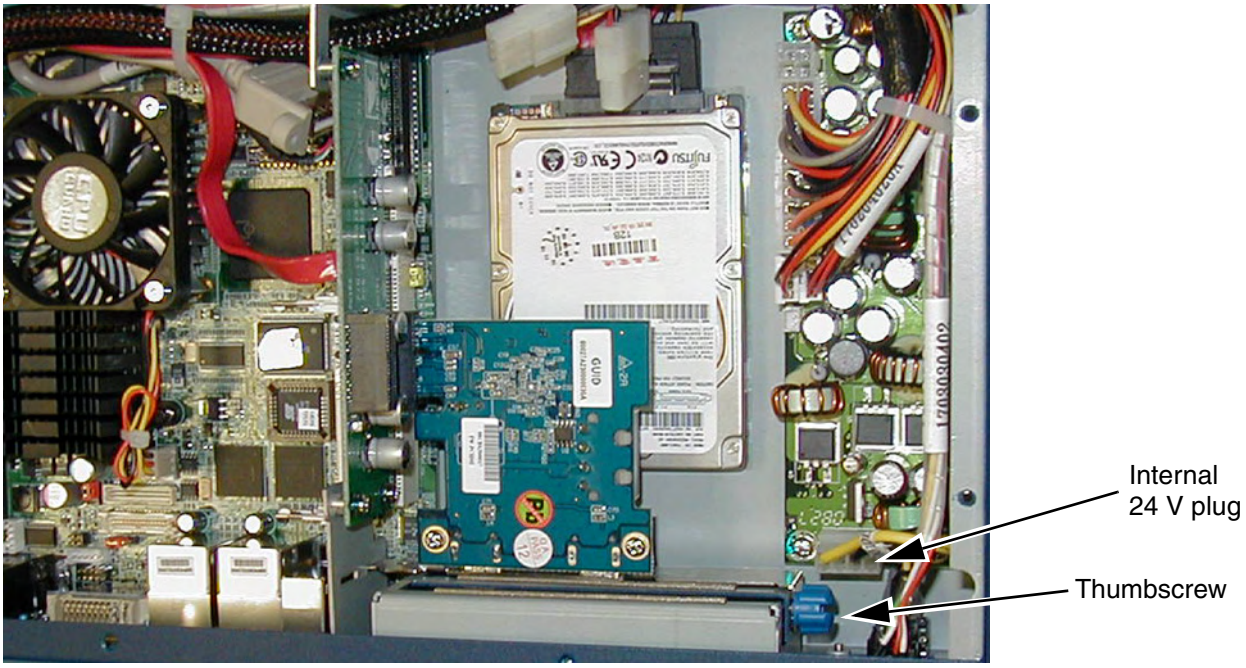


Figure 5-5. Internal 24 V Power Plug

3. Remove the PCIe blanking plates.

   One blanking plate covers each empty expansion slot. If you are replacing an existing PCIe card, the blanking plate will have already been removed.

4. Install the PCIe card. Ensure that it physically clicks into place.

5. Attach the PCIe card to the frame with a thumbscrew. See the preceding figure.

6. For 1394 cards, plug the power cable into the PCIe card.

   If the 24 V power cable is cable-tied to other wires, cut the cable tie to free enough wire to reach the PCIe card.

   NOTE: GigE cards do not need a 24 V power connection. A GigE camera, however, requires 24 V supplied at the camera.
   The I/O card does not require a 24 V power connection.

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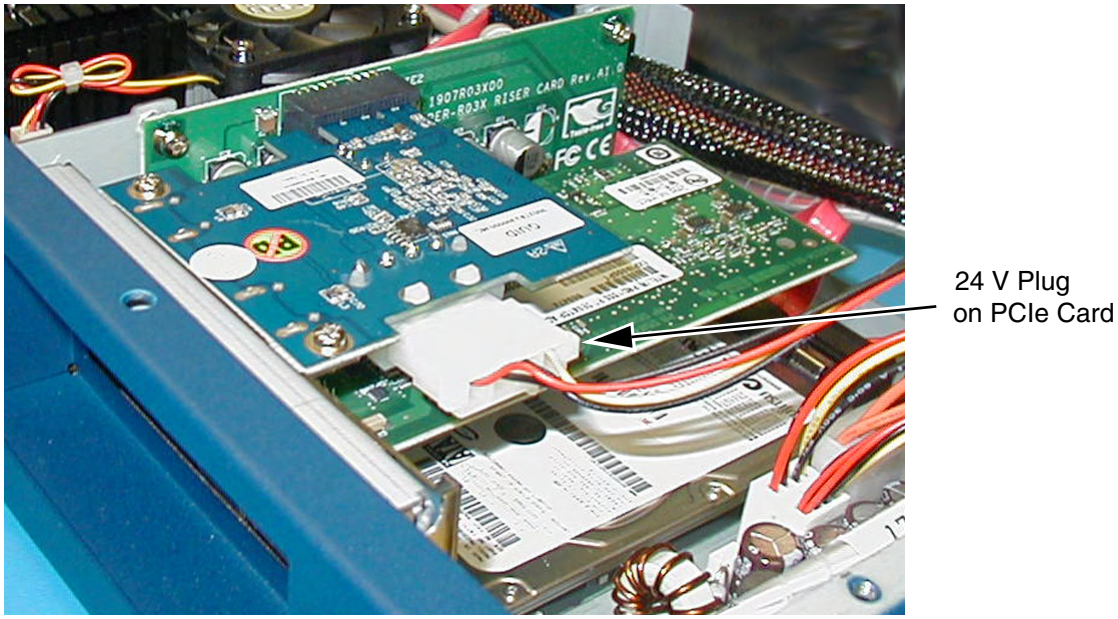


Figure 5-6. PCIe Power Plug (not fully inserted)

7. After installing PCIe card(s), reconnect the internal 24 V plug. Refer to **Figure 5-5**.
8. Cable-tie any unused power cables to nearby cables, to keep them out of the way.
9. Run the tests in **"PCIe Card Check" on page 47** after installing any PCIe cards.
10. Reinstall the Adept SmartVision EX top cover.

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5.7 Replacing the USB License Dongle

The USB license dongle tells the Adept ACE software what licenses have been purchased. The available licenses are covered in **"License Options" on page 37**.



Figure 5-7. USB Dongle

In the event that you purchase additional licenses after you have received your Adept SmartVision EX unit, you will need to replace your existing dongle with a new one. The instructions for replacing the dongle follow:

1. Remove the top cover of the Adept SmartVision EX.
2. Remove the existing dongle.
3. Plug in the new USB Dongle and secure as shown.

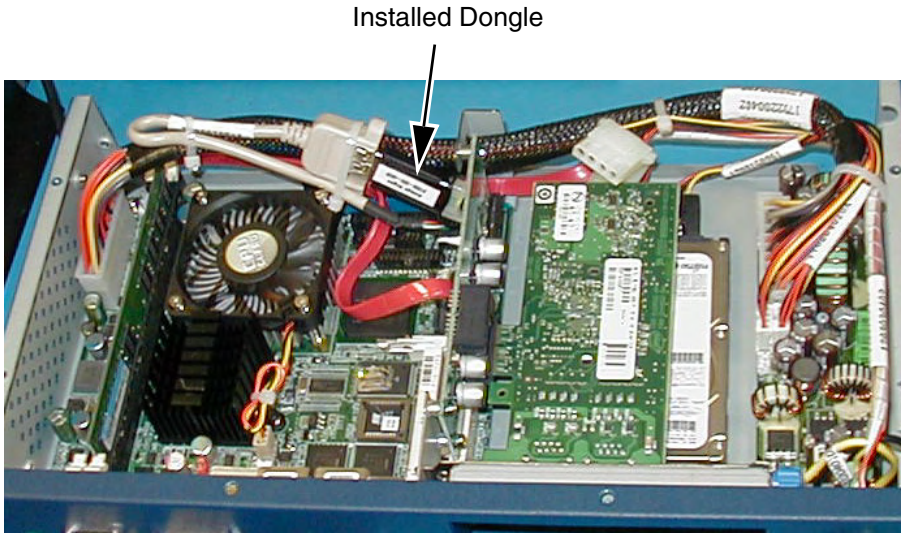


Figure 5-8. Location of USB License Dongle

4. Reinstall the top cover of the Adept SmartVision EX.

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6 PCIe Card Check

This chapter gives procedures for verifying that all of the ports in PCIe expansion cards are functioning correctly.

To perform these procedures, you will need:

- A functional Adept SmartVision EX unit
- A monitor, connected to the Adept SmartVision EX unit
- A mouse, connected to the Adept SmartVision EX unit
- For checking camera port cards:
  - A camera compatible with each type of PCIe camera port you want to check
  - Cables for the cameras to be checked

    For a GigE camera, this requires both Ethernet and a Hirose 12-pin cable. You will have to supply power to the camera through the Hirose cable.
- A keyboard, connected to the Adept SmartVision EX unit (optional)

To test the PCIe cards, you will:

- Start Adept ACE
- Open an Example Workspace
- For camera support PCIe cards
  - Add the appropriate cameras to the workspace
  - Verify that each port of each PCIe card is functional
- For I/O cards
  - Verify that inputs and outputs are recognized by Adept ACE software

6.1 Starting Adept ACE and Creating an Example Workspace

1. Turn on the Adept SmartVision EX unit and wait for it to finish booting.
2. Double-click the Adept ACE icon on the desktop.

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3. In the following dialog, select Create Example Workspace and then click Open.

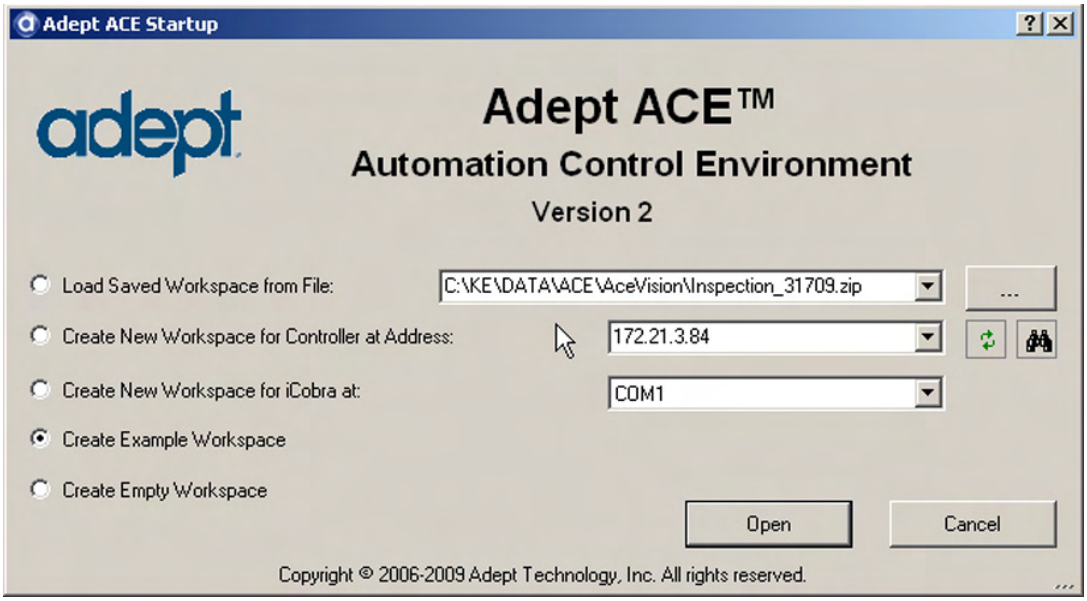


Figure 6-1. Adept ACE Startup Screen

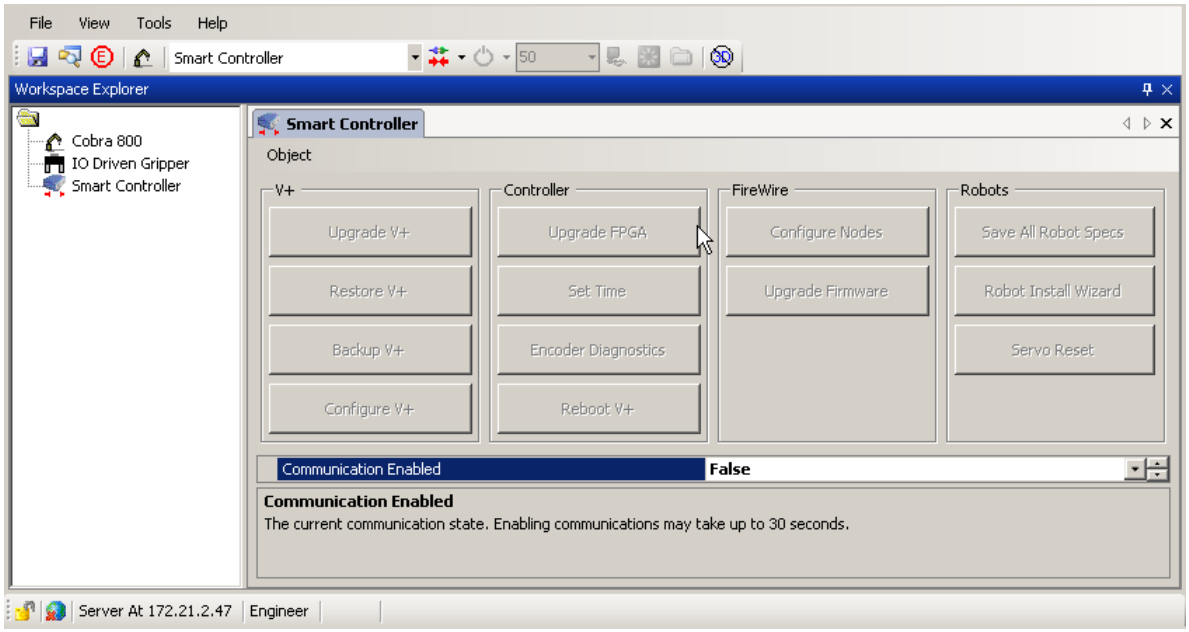


Figure 6-2. Initial Screen, after Creating Example Workspace

Connecting a Basler Camera

For Basler 1394 cameras, connect a 1394 cable between the camera and the 1394 PCIe card.

For Basler GigE cameras, connect an Ethernet cable between the camera and the GigE PCIe card.

NOTE: GigE cameras requires a separate DC power cable (Hirose) to the camera.

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Adding a Camera to the Workspace

1. Right-click in the blank space below the folder in the Workspace Explorer (on the left side), then select **New > Vision > Device > Basler Pylon Device**.
2. Make sure that the "Create a virtual camera" box is checked.
3. Highlight the camera name under Available Devices and click Finish.

   In the following illustration, the camera name is a601f (cdf13801533000). The a601f is a Basler model number; the parentheses contain a serial number. Your numbers will vary.



Figure 6-3. Adding a Camera

4. Click the Basler Pylon Device tab.

   If the camera name is already displayed in the Device Name field, skip to **Step 5**.

   a. Select **Configuration > Device Name**.

   b. Click the down arrow, to display the available cameras.

   c. Click the camera name.

5. Click **View > Vision Window**. This will put a tab for the Vision Window beneath the operating window and open the Vision Window.

   Drag the Vision Window, by its title bar, to the bottom or right position locator, so you can see both the Workspace and Vision Window at the same time. Make sure your window is large enough to display both the Workspace and the Vision Window.

6. Click the Basler Pylon Device Virtual Camera tab:

   If the tab for the virtual camera is not displayed, double-click on the Basler Pylon Device Virtual Camera object in the left pane to open the object editor and create a tab for it.

   a. Click **Configuration > Device**.

   b. Click the down arrow, to display the available devices.

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c. Select the Basler Pylon device, and click OK.

d. In the Calibrations pane, click the Add icon.

e. Select either Grid or Fixed Pixel Calibration, then click Accept.

Because you are only checking that the camera port works, selecting Fixed Pixel calibration will save you the effort of performing a calibration with a calibration grid.

f. If you selected Grid Calibration, click the Live icon, focus the camera on the grid, then click Stop.

Set Dot Pitch to the grid you are using (typically 10 mm).

Click Calibrate, then Accept.

The appropriate calibration unit in the Calibrations pane should now have a check mark.

Testing the PCIe Camera-support Cards

1. For 1394 cameras, test all ports:
   a. Click the Live icon to verify that the port works.
   b. Click Stop.
2. If there are two PCIe cards for camera support installed, test the second card, too.
3. After testing all the camera support ports, exit Adept ACE.

   Click No when asked to save the workspace.

Testing the PCIe I/O Card

NOTE: If you get no response from the I/O card, check the event log in Adept ACE. If the line:

"Optional IO board not installed"

is shown, the Adept SmartVision EX or Adept ACE are not recognizing the I/O card.

Minimum Adept ACE Revision

The driver for the Adept SmartVision EX PCIe I/O card is shipped concurrent with Adept ACE 2.2 (image part number 28962-203) and later.

Test Procedure

You will need something connected to the inputs and outputs of the card to verify that it is functioning correctly.

1. Connect the cable and terminal block to the I/O card.
2. Connect an appropriate device, such as an LED, to one or more of the card outputs.

   This can be anything that will indicate that the card is, in fact, turning on the output line that you select.

   See the pinouts for the output channels. See **Table 5-1, "I/O Card Pin Assignments," on page 39**
3. Open Adept ACE.

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4. Click the Local Digital I/O icon.

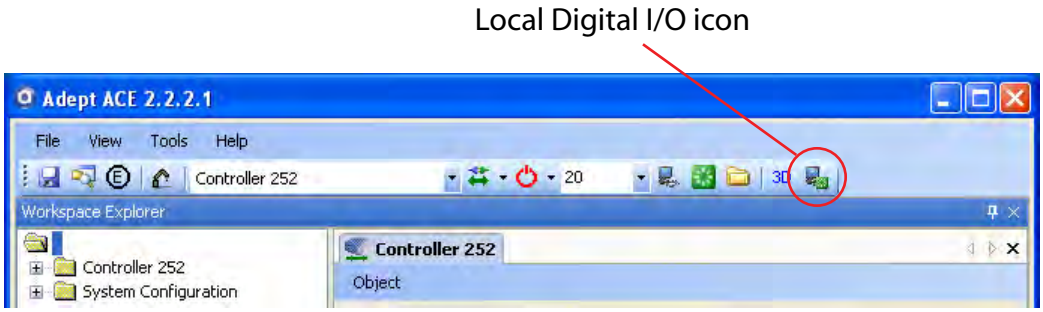


Figure 6-4. Local Digital I/O Icon

The following pane will open:

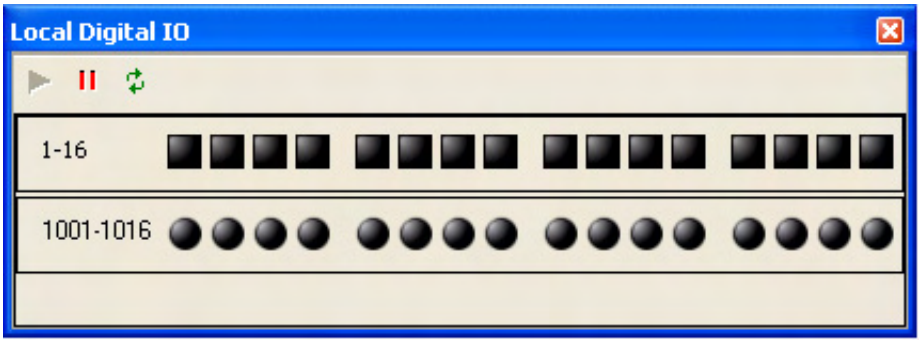


Figure 6-5. Local Digital I/O Pane

5. From the Local Digital I/O pane, turn on the outputs needed to drive the device(s) you connected to the card.
6. Verify that the output is working.
7. Set some inputs, for example, by activating a switch that pulls an input line high. Refer to **Figure 5-2 on page 42**.

Programmatic I/O Control

Refer to the *Adept ACE User's Guide* for information on using numeric variables for programmatic control of the I/O card.

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Adept SmartVision EX Configuration 7

The configuration of a Adept SmartVision EX unit can be managed remotely, from an attached PC running the SmartVision EX Utility, or locally, from the unit itself, using Windows.

The SmartVision EX Utility is supported on:

- Windows Vista
- Windows XP
- Windows Server 2003
- Windows Longhorn
- Windows 2000

The SmartVision EX Utility will NOT run on:

- Windows NT 4.0
- Windows Me
- Windows 98 Second Edition
- Windows 98
- Windows 95

7.1 Remote Configuration (the SmartVision EX Utility)

The SmartVision EX Utility allows you to configure Adept SmartVision EX units from a remote PC. The Utility, which is distributed as a part of Adept ACE, can be used to:

- Locate all Adept SmartVision EX units on your network
- Select one Adept SmartVision EX unit to configure
- Assign a display name to the selected unit
- Configure Adept SmartVision EX network interface cards on the selected unit
- Copy event logs from the selected unit to the remote PC
- Lock or unlock the write filter for the selected unit (protects C: drive)
- Reboot the selected unit
- Install/upgrade the Adept ACE software on the selected unit

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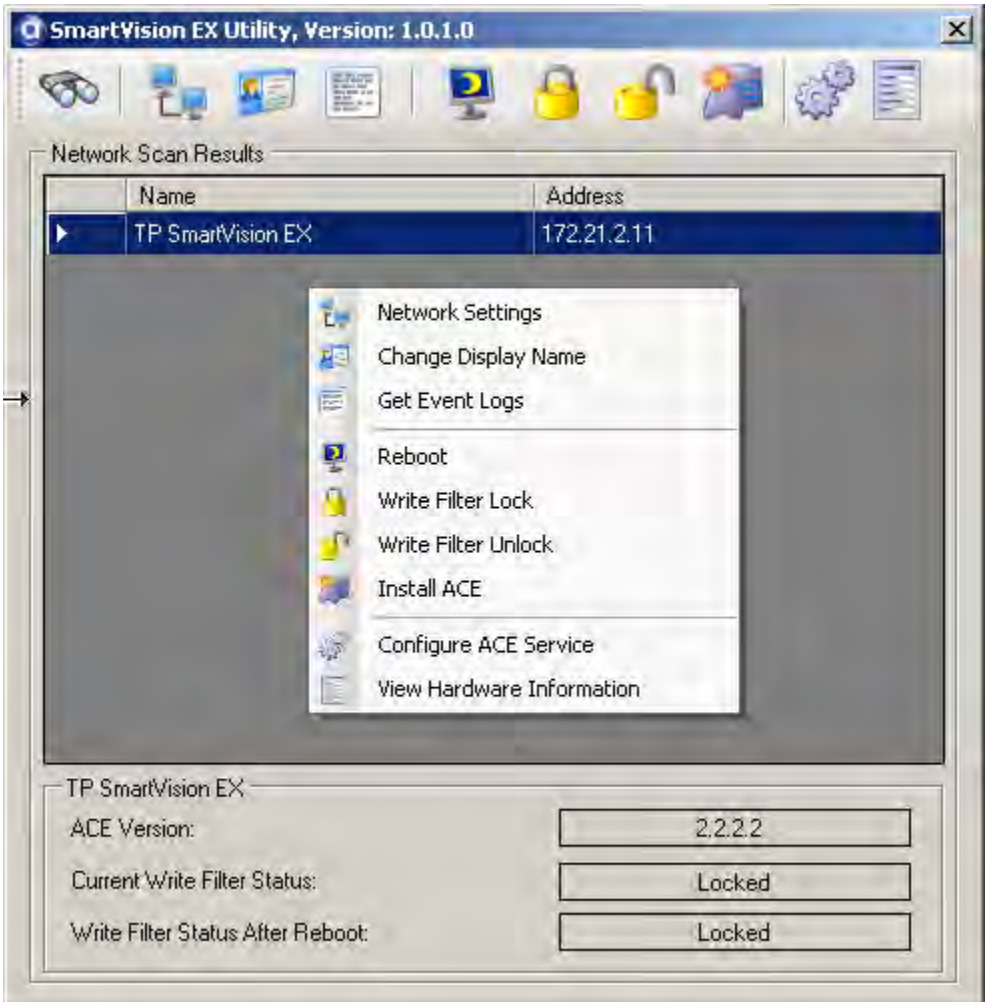


Figure 7-1. SmartVision EX Utility Screen (after right-click)

The SmartVision EX Utility is accessed through the Windows® Start button:

1. **Start > Programs > Adept Technology > SmartVision EX > SmartVision EX Utility Client**

The utility operates on a single Adept SmartVision EX unit. To select a specific Adept SmartVision EX unit, run Scan, and then click on the name of the unit you want to configure.

You can right-click in the opening screen to display a list of available actions. See the preceding figure.

Scan

Scan locates all Adept SmartVision EX units on the network, and displays the name and IP address of each.

Selecting an Adept SmartVision EX from the Scan window will display the unit's:

- Installed Adept ACE version
- Current session Write Filter status (Locked/Unlocked)

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- Next session Write Filter Status After Reboot status (Locked/Unlocked)

  The Current Write Filter Status and Write Filter Status After Reboot will usually be the same. Session refers to the Adept ACE session, and becomes a new session when the Adept SmartVision EX unit is rebooted.

Display Name

You can assign a name to each Adept SmartVision EX unit on your network, to help you identify which unit you're working with.

1. Select an Adept SmartVision EX unit by clicking on its current name.

   The names will default to SmartVision EXn, where n is incremented for each unnamed Adept SmartVision EX unit found on the network. The first name will be: SmartVision EX1.

2. Click on Change Display Name.
3. Type in a new name for the Adept SmartVision EX unit, and click Accept.

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Network Settings

Network Settings opens a window for configuring network interface cards (NICs) in the selected Adept SmartVision EX. Clicking on the Network Settings icon opens a window that displays the available network interface cards. There are two NICs on each Adept SmartVision EX motherboard.

To change the settings on one of the cards, click on the name of the card to select it. The lower portion of the window will be populated with current settings for that card. Refer to the following figure.

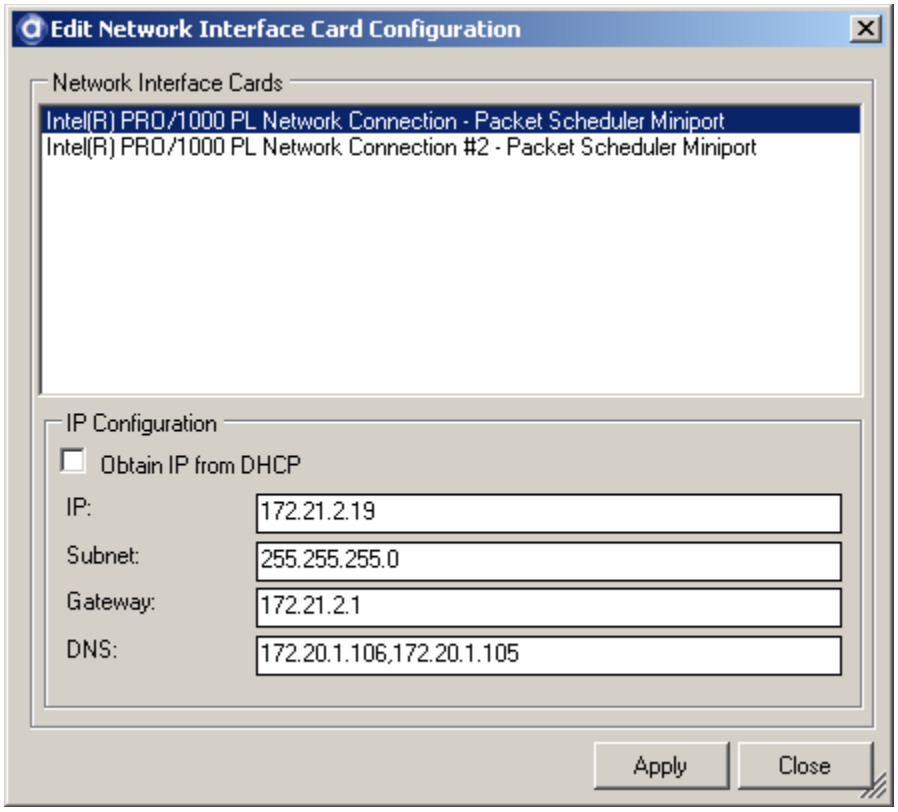


Figure 7-2. Network Interface Card Configuration Screen

When you are finished setting the NIC configuration, click Apply.

The Adept SmartVision EX unit will automatically reboot, to apply the changes.



Figure 7-3. NIC Configuration Reboot Message

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Get Event Logs

Get Event Logs copies the Windows log files from the Adept SmartVision EX to your local PC.

- You select the directory into which a copy of the log files will be placed.
- You can then use the Windows event viewer to view the log files, or you can send them to someone else for troubleshooting.

Hard Drive Utilities

The internal hard drive is partitioned into C: and D: drives. The C: drive, which contains the Widows® XP Embedded operating system and Adept ACE software, is protected by default with a file-based write filter. **Figure 7-1 on page 54** shows the unit with current and next write filters locked.



CAUTION: Possible data loss. Please read the following two paragraphs.

When the file-based write filter is active, changes made to the C: partition are actually written to RAM, as part of the mechanism of the file-based write filter. During your session, these changes will appear to have been made on C:, but will not, in fact, be saved to the hard drive. Any such changes will be lost the next time the Adept SmartVision EX is power-cycled.

Because of this, user files and programs should be put on the D: partition. Because the write filter only applies to the C: partition, this also allows you to write to the files without disabling the write filter, and any such changes will be saved to the hard drive.

Write Filter

If you ever need to upgrade the Adept ACE software, you will first need to unlock the write filter, and reboot the Adept SmartVision EX unit. The unit will then boot with the C: drive write filter unlocked.

> **NOTE:** Event logs are written to the D: drive, so the write filter does not affect them.

Once the Adept ACE software is upgraded, you should reset the write filter to Locked, and reboot the Adept SmartVision EX unit, so the Adept ACE software is protected.

Write Filter Lock

Write Filter Lock sets the write filter to Locked for the selected Adept SmartVision EX unit. Locked is the default condition, so the C: drive is normally protected.

- Attempting to upgrade (Install) Adept ACE when the write filter is locked will result in an error message.
- A change in the write filter setting will not be applied until the Adept SmartVision EX unit is rebooted.

Write Filter Unlock

Write Filter Unlock sets the write filter to Unlocked for the selected Adept SmartVision EX unit.

A change in this setting will not be applied until the Adept SmartVision EX unit is rebooted.

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Reboot

This reboots the selected Adept SmartVision EX unit. This ends the current Adept ACE session, and applies the Write Filter Status After Reboot to the new Adept ACE session.

After a reboot, you will need to click on Scan for the configuration utility to find the Adept SmartVision EX unit that was rebooted.

Install ACE

The Adept ACE software can be upgraded for the selected Adept SmartVision EX unit by connecting the Adept SmartVision EX to a PC that has the upgrade software. The upgrade will re-install the Adept ACE software.

1. Connect the PC with the upgrade software to the Adept SmartVision EX.

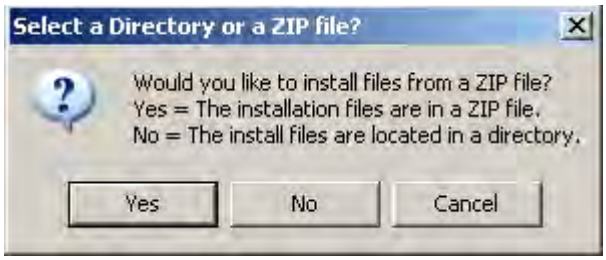
   Use an Ethernet connection from the PC to a LAN port on the Adept SmartVision EX.

2. Click Unlock and then Reboot, so the utility can write to the C: drive.

   Wait for the unit to reboot.

3. Click Install ACE.

   - You will be asked if the source files are in a zip file or in a directory.



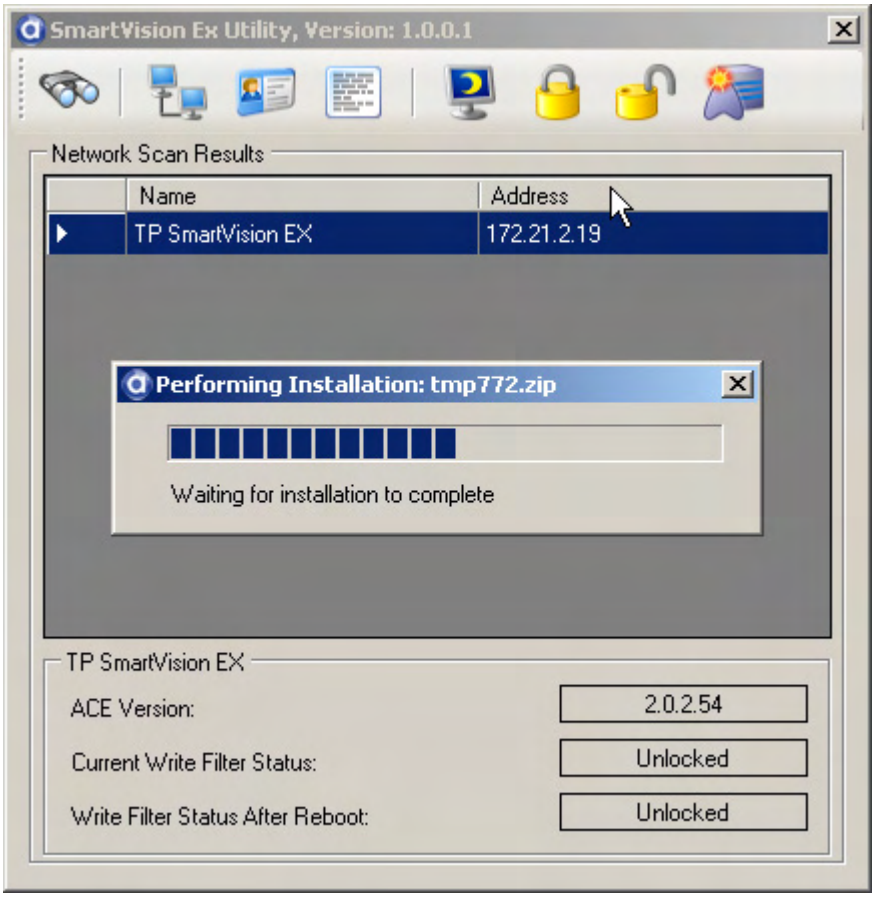
   If you are installing from a directory, make sure that the directory structure in the Adept ACE source is preserved. This will likely have the subdirectories AUTOMENU, DirectX9c, and ISSetupPrerequisites, as well as some files at the root level.

   If you are extracting the source files from a zip file into a directory (this is recommended if the zip file is password-protected), make sure that you have checked “All files/folders in archive” and “Use folder names” before extracting.

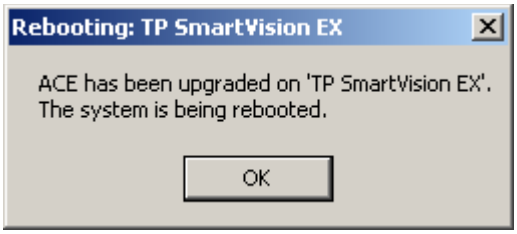
   - You will be asked where the zip file or directory is.

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The utility will display a status bar as it upgrades Adept ACE:

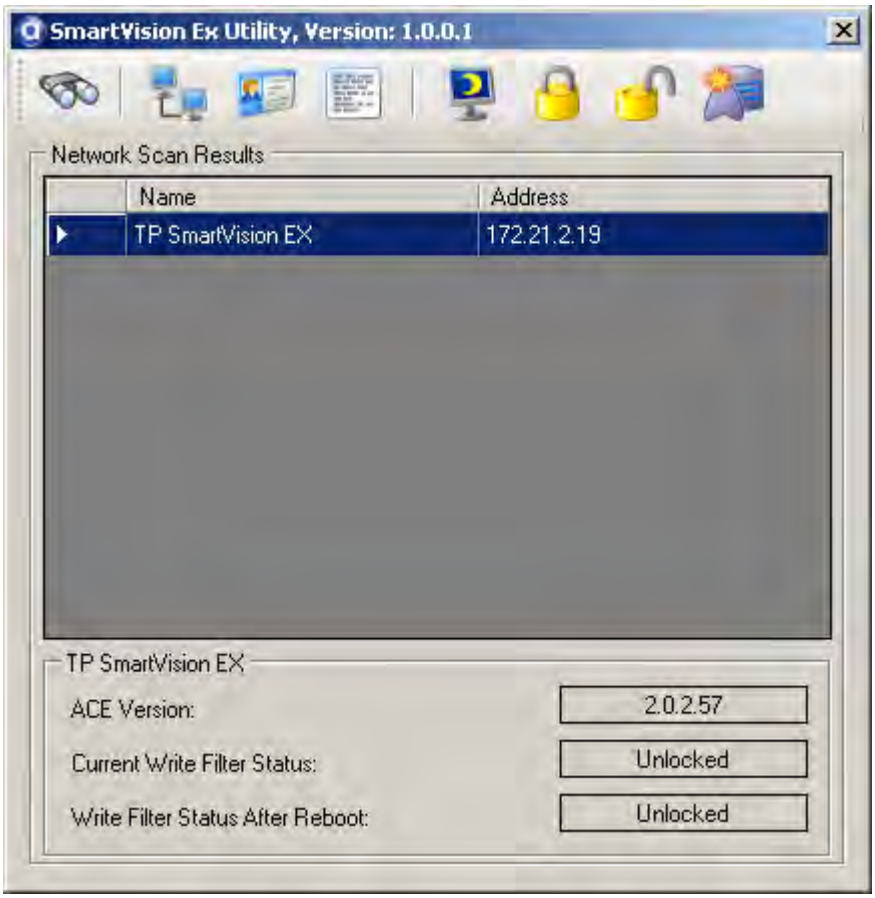


4. When the installation is completed, the utility will display a window saying that the Adept SmartVision EX unit is being rebooted. Click OK.



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The utility will boot with the write filter unlocked, and the new version of Adept ACE displayed:



5. Click Lock, then Reboot. This will boot with the C: drive, containing the Adept ACE software and the Windows XPe OS, protected.

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Configure ACE Service

With Configure ACE Service, you can:

- Stop or start the Adept ACE Service
- Set the Adept ACE Service to start automatically when the Adept SmartVision EX is booted

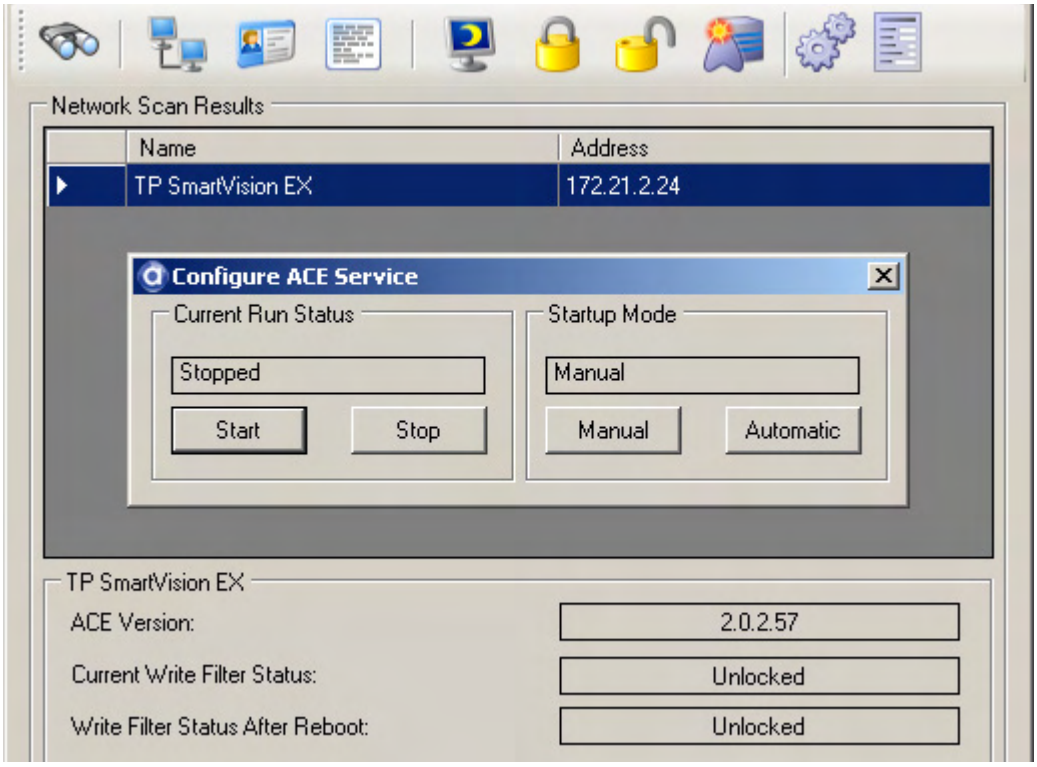


Figure 7-4. Configure ACE Service

The write filter on the Adept SmartVision EX must be unlocked to run Configure ACE Service.

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View Hardware Information

View Hardware Information displays the part number of the operating system.

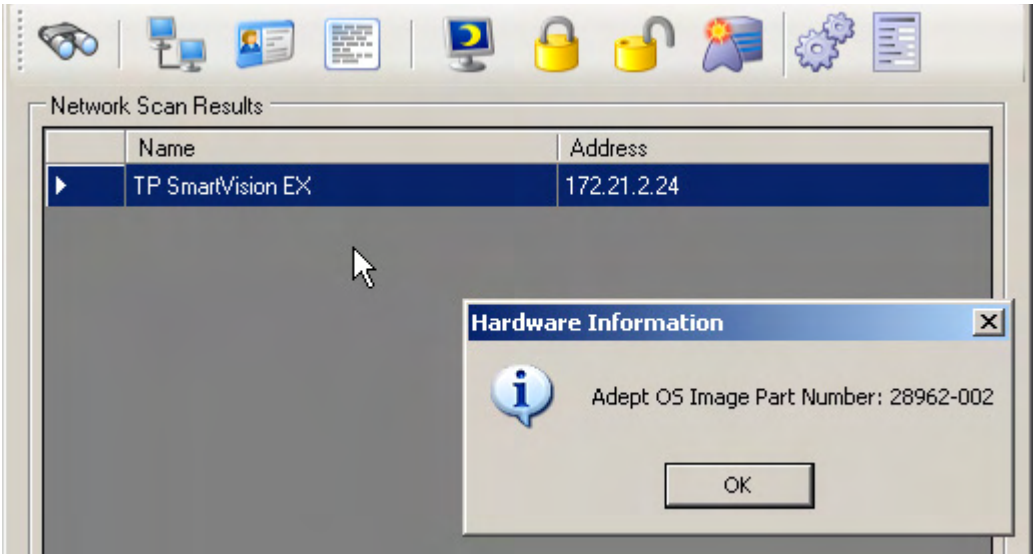


Figure 7-5. VIew Hardware Information

The write filter on the Adept SmartVision EX does not need to be unlocked to run this.

7.2 Local Configuration

Upgrading Adept ACE

This section covers the procedure for upgrading Adept ACE from the Adept SmartVision EX on which it resides.

Tasks

- Disable write filter
- Upgrade Adept ACE software
- Re-enable write filter

Disabling the Write Filter

1. From the Windows desktop screen, click **Start > All Programs > FBWF > FBWF Disable**.

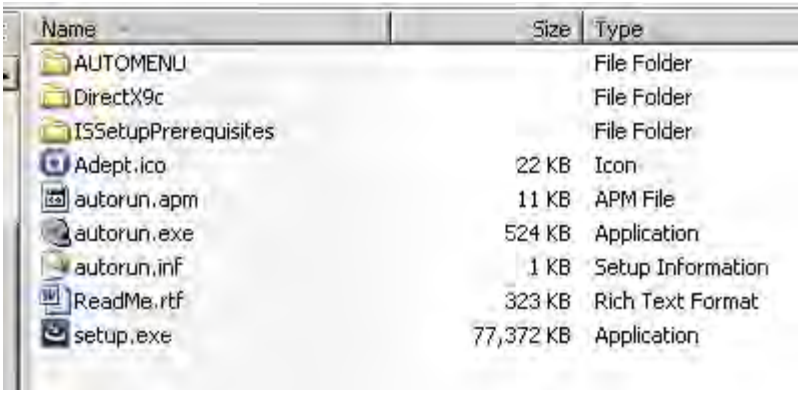
   A window will display a message that the write filter will be disabled after the next reboot.

2. Reboot the Adept SmartVision EX unit.

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Upgrading the Adept ACE Software

1. From the Adept ACE upgrade files, run autorun.exe.



   NOTE: If the upgrade does not change the Adept ACE version number, the write filter may not have been disabled.

2. Reboot the Adept SmartVision EX.

Re-enabling the Write Filter

1. From the Windows desktop screen, click **Start > All Programs > FBWF > FBWF Enable**.

   A window will display a message that the write filter will be enabled after the next reboot.

2. Reboot the Adept SmartVision EX.

Checking the Write Filter Status

From the Windows desktop screen, click **Start > All Programs > FBWF > FBWF Information**. A window will display the current status of the write filter.

Setting the IP Address

NOTE: The Adept SmartVision EX runs XP embedded, so you change the IP address the same way as you would on a PC.

NOTE: This change will only be permanent if the file-based write filter was disabled when the Adept SmartVision EX last booted.

1. Click **Start > Network Connections**.
2. Right-click on the local area connection you want to change.
3. Click Properties.
4. Scroll down to Internet Protocol (TCP/IP) and click on it.
5. Click Properties.
6. Click the radio button "Use the following IP address:".
7. Enter your IP address and a subnet mask of 255.255.0.0.
8. Click Ok.
9. Click Ok again to close the local area connection window and save settings.

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Checking the Licenses on the Dongle

You can see what has been enabled on a dongle with the following procedure:

1. Turn on the Adept SmartVision EX unit and wait for it to finish booting.
2. Double-click the Adept ACE icon on the desktop.
3. Select Create Example Workspace, then click Open.
4. Click **Help > Diagnostic Summary**.

   Adept ACE will display a list of all options that can be licensed by the dongle, and indicate which ones have been enabled.

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8 Technical Specifications

This chapter gives the technical specifications and dimensions of the Adept SmartVision EX.

8.1 Processing Specifications

Table 8-1. Processing Specifications

CPU	Intel® Core Duo, dual 64-bit cores, 2.16 GHz
Memory	2 GB DDR2
Operating System	Windows® XP Embedded
Hard Drive	80 GB (2.5 in.)

8.2 Environmental Specifications

The Adept SmartVision EX must be shipped and stored in a temperature-controlled environment. Refer to the following table.

Table 8-2. Environmental Specifications

Ambient temperature	5° to 40° C
Storage and shipment temperature	–25° to +55° C
Humidity range	5 to 90%, non-condensing
Altitude	up to 2000 m (6500 feet)
Free space around Adept SmartVision EX (for proper cooling)	10 mm at back, 13 mm on sides
Chassis protection class	IP-20 (NEMA Type 1)

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8.3 Power Requirements



CAUTION: Make sure you select a 24 VDC power supply that meets the specifications in the following table. Using an underrated supply can cause system problems and prevent your equipment from operating correctly. See Table 8-4 for recommended power supplies.

Table 8-3. Power Specifications

Customer-Supplied Power Supply	24 VDC (-10%, +5%), 150 W (6 A)
Typical Power Consumption	2.5 A
Maximum Power Consumption	6.0 A
Circuit Protection	Not more than 8 A (below the amperage rating of the cable used).
Power Cabling	1.5 - 1.85 mm^2 (16-14 AWG), full-cover, braided shield cable, maximum length 10 meters
Shield Termination	Braided shield connected to the marked frame ground screw on the front of the Adept SmartVision EX (near the VDC connector). On the other end of the cable, the shield should be connected to the power supply chassis.

Table 8-4. Recommended 24 VDC Power Supplies

Vendor Name	Model	Ratings
XP Power	JPM160PS24	24 VDC, 6.7 A, 160 W
Mean Well	SP-150-24	24 VDC, 6.3 A, 150 W
Astrodyne	ASM150-24	24 VDC, 6.66 A, 150 W

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8.4 Dimensions

This section gives the dimensions and weight of the Adept SmartVision EX.

Table 8-5. Physical Specifications

Weight		2.69 kg (5.92 lbs)
Dimensions:	Width	328.9 mm (12.9 in.)
	Depth	185.4 mm (7.3 in.)
	Height	63.6 mm (2.5 in.) box only 69.4 mm (2.73 in.) with feet

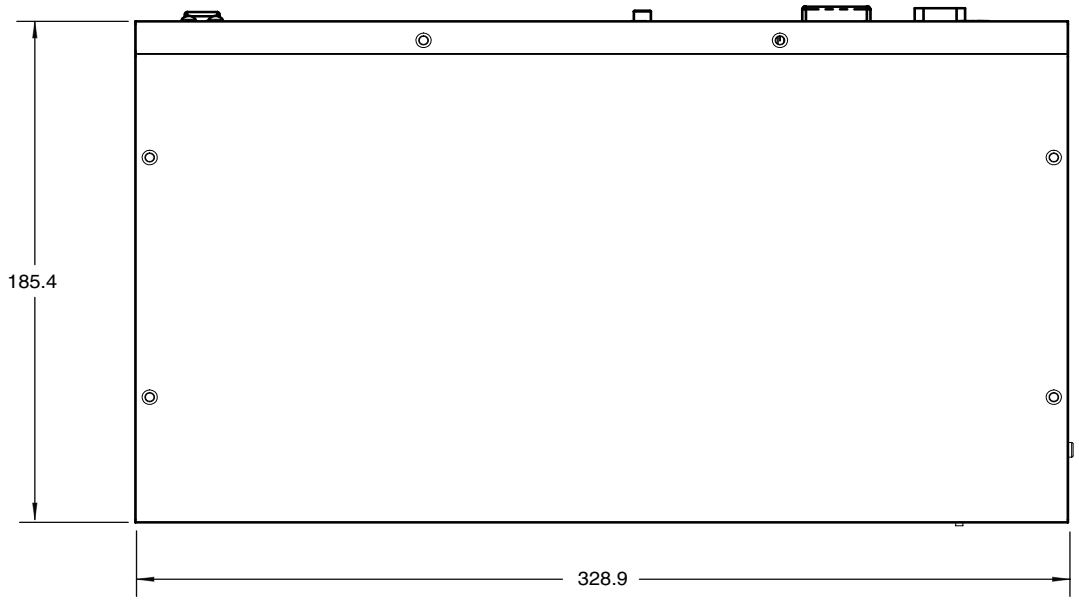


Figure 8-1. Top Dimensions

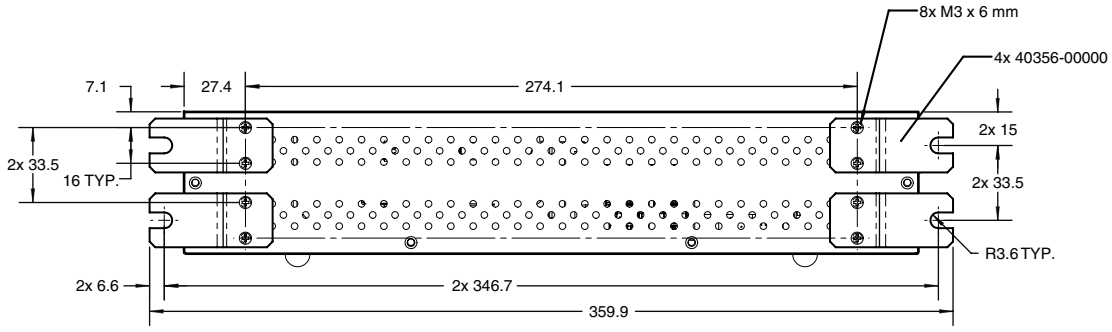


Figure 8-2. Back Dimensions (Panel Mount shown)

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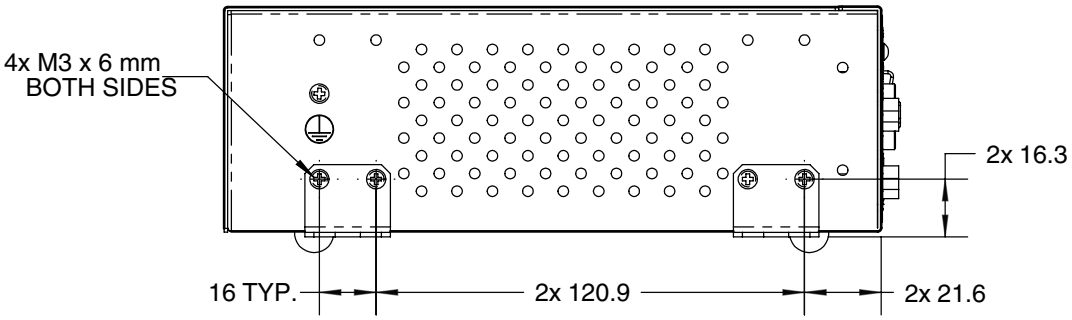


Figure 8-3. Side Dimensions

8.5 Connections

External

- 10/100/1000 Ethernet x 2
- USB 2.0 x 4
- RS-232 (DB9M) x 2
- VGA (HDB15F)
- DVI
- PS/2 Mouse
- PS/2 Keyboard
- Audio In (not used)
- Audio Out (not used)
- Microphone Jack (not used)

Internal

- USB 2.0 (for license dongle)
- PCIe card slots x 2 (see **Chapter 5**)

Optional

Up to two PCIe cards:

- IEEE-1394a x 2 ports
- IEEE-1394b x 3 ports
- GigE x 1 port
- 50-pin I/O card x 1 port

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