

KEITHLEY

CH-EXP Series

User's Guide

A GREATER MEASURE OF CONFIDENCE

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The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the manual for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the manual. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, and perform safe installations and repairs of products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are rated Installation Category I and Installation Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Installation Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Installation Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the Manual.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. **A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.**

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 volts, **no conductive part of the circuit may be exposed.**

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, make sure the line cord is connected to a properly grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided, in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.

The instrument and accessories must be used in accordance with its specifications and operating instructions or the safety of the equipment may be impaired.

Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.

When fuses are used in a product, replace with same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.

If  or  is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the manual.

The  symbol on an instrument shows that it can source or measure 1000 volts or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The **WARNING** heading in a manual explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in a manual explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits, including the power transformer, test leads, and input jacks, must be purchased from Keithley Instruments. Standard fuses, with applicable national safety approvals, may be used if the rating and type are the same. Other components that are not safety related may be purchased from other suppliers as long as they are equivalent to the original component. (Note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product.) If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

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1

Preface

This manual serves both designers of systems and users of Keithley's CH-EXP Series Expansion Chassis. It provides specifications, installation, and application information.

This manual is organized as follows:

- **Chapter 1 - Introduction** provides an overview of the CH-EXP series of expansion chassis, including configuration, power supplies, backplane layout, specific aspects of the enclosable housing, and the specifications for power supplies, operating environment, and expansion chassis construction.
- **Chapter 2 - Installation** describes how to mount an expansion chassis in an equipment rack and install accessory boards in the backplane of an expansion chassis.
- **Chapter 3 - Expansion Chassis Interface Kit** provides an overview of the CH-EXP Series Interface Kit and procedures for connecting the interface kit to an expansion chassis and a host computer.
- **Chapter 4 - Maintenance and Repair** provides information on filter maintenance and on troubleshooting the operation and use of a CH-EXP Series Expansion Chassis.
- **Chapter 5 - Factory Return Information** provides information on Keithley's repair and return policy.

1

Introduction

The CH-EXP Series Expansion Chassis enable you to increase the number of available I/O slots of a host computer. The expansion chassis are self-contained IBM-compatible enclosures complete with power supply, fan cooling, harnessing, and a passive backplane that can accept IBM PC-type accessory boards, including CPU boards. Expansion chassis are available for IBM PC/AT bus configurations (or their equivalents). Current models include the 6-slot and 14-slot versions listed in Table 1-1.

Table 1-1. CH-EXP Model Numbers

Model Number	Slots	Type
CH-EXP12	12 full slots, 2 2/3 slots	Rack-mount
CH-EXP4	6 full slots	Table-top

The CH-EXP12 is a heavy duty rack-mount chassis engineered to meet the tough reliability requirements of the industrial environment. Figure 1-1 shows the dimensions of the CH-EXP12 Expansion Chassis. The CH-EXP4 is a versatile table-top chassis suitable for laboratory or portable applications. Figure 1-2 shows the dimensions of the CH-EXP4 Expansion Chassis. All CH-EXP Series chassis are manufactured in the USA.

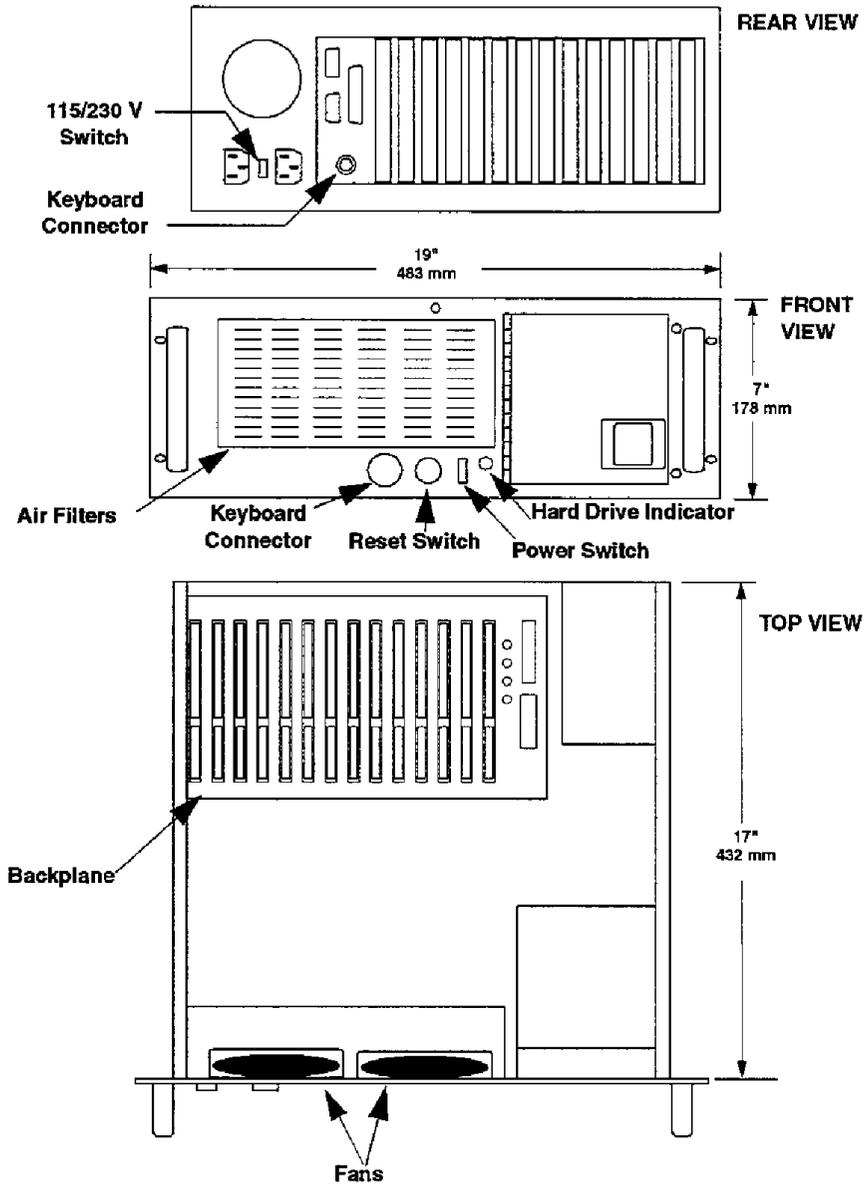


Figure 1-1. CH-EXP12: Dimensions

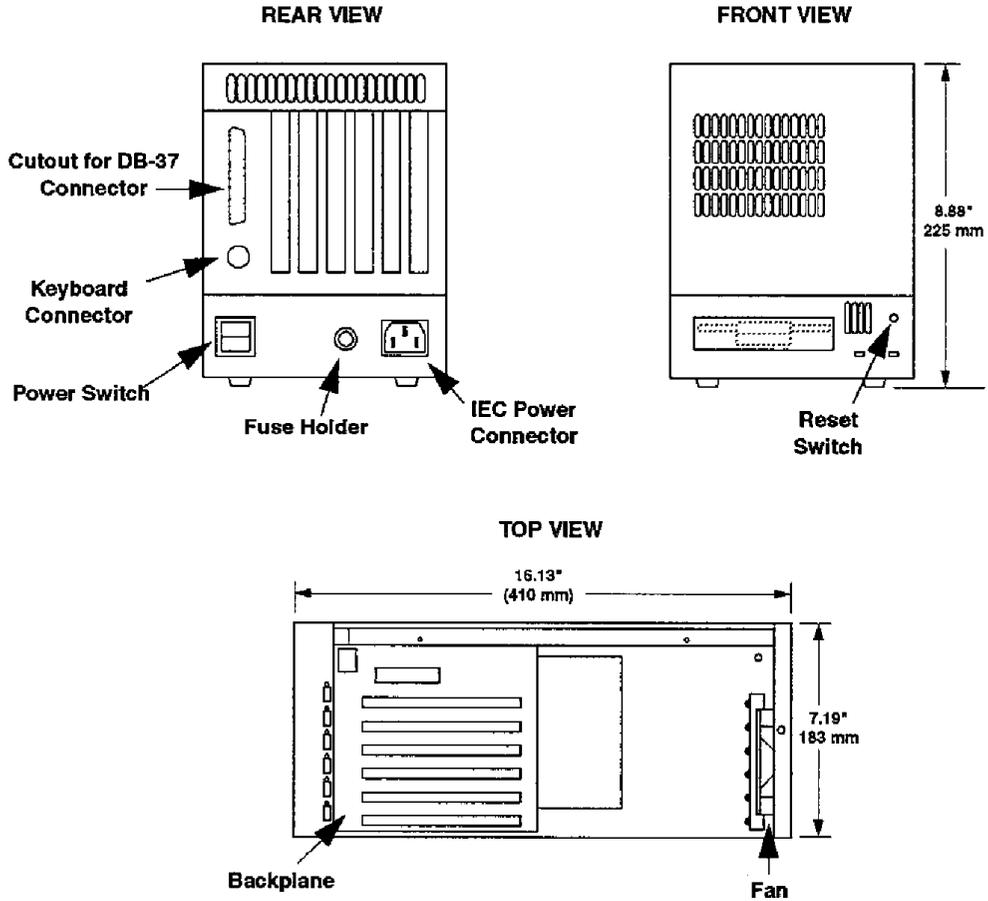


Figure 1-2. CH-EXP4: Dimensions

The sections that follow describe specific aspects of the two expansion chassis and provide specifications for each.

Configuration Choices

You can configure either expansion chassis for one of two modes:

- as a stand-alone computer, or
- as an extension to your computer.

Configuring the expansion chassis for stand-alone operation requires a CPU board plus any additional components you may require. For example, you may add a video board to support a local monitor, a disk controller board for hard-disk and floppy drives, a keyboard interface, and/or other components.

Configuring to extend the accessory board capacity of an existing computer requires use of the interface kit furnished with your expansion chassis. This kit contains an adapter board for the host, an adapter board for your expansion chassis, and a cable for connecting the boards. In this configuration, the CH-EXP12 adds an additional 11 full slots and 1 2/3 slot to the system while the CH-EXP4 adds 4 full slots. Multiple expansion chassis may be used with a single host computer. The Expansion Chassis Interface Kit is fully discussed in Chapter 3.

Backplane Layout

Backplane components for each expansion chassis include full-length accessory board slots and LED indicators for each power supply output. The backplane layout for the CH-EXP12 is shown in Figure 1-3. The backplane layout for the CH-EXP4 is shown in Figure 1-4.

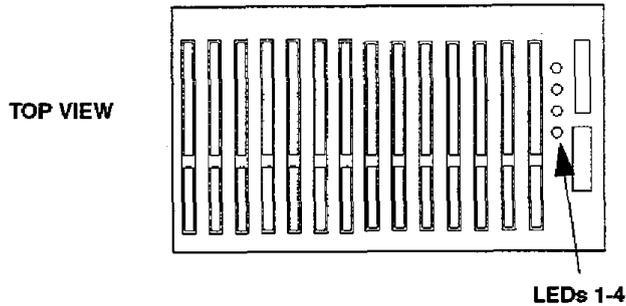


Figure 1-3. Backplane Layout for the CH-EXP12

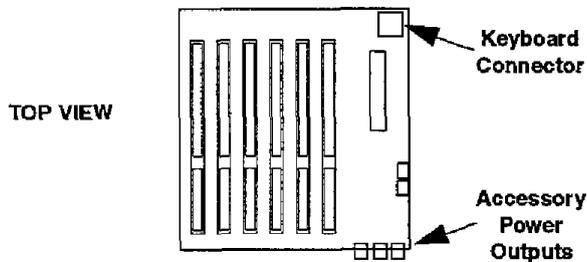


Figure 1-4. Backplane Layout for the CH-EXP4

Power Supplies

The power supplies provide ± 5 VDC and ± 12 VDC to the passive backplane. They deliver up to 300 W for the CH-EXP12 and 65 W for the CH-EXP4. For the CH-EXP12, up to 30 A at +5 V is available; for the CH-EXP4, up to 10 A at +5 V is available. For additional power supply information, refer to Table 1-2 on page 1-7 if you are using a CH-EXP12 expansion chassis, or to Table 1-3 on page 1-10 if you are using a CH-EXP4 expansion chassis.

Disk Drives

The CH-EXP12 can accommodate up to three externally accessible half-height 5¼-inch floppy disk drives as well as one internal 3½-inch hard-disk drive. The CH-EXP4 can accommodate one externally accessible 3½-inch floppy disk drive as well as one internal 3½-inch hard-disk drive.

Cooling and Filtration

The CH-EXP12 contains two 80 CFM fans in the front panel as well as a 40 CFM fan in the power supply module. An easy-access air filter located on the front panel (shown in Figure 1-1) protects the system from environmental dirt and grit. This filter can be removed and cleaned without turning power off or opening the expansion chassis by removing the four air filter screws on the front panel.

The CH-EXP4 has a single 42 CFM fan in the card-cage area. All fans provide positive pressurization of the entire system, including the disk drives. The CH-EXP4 does not contain air filters.

Specifications

Table 1-2 lists specifications for the CH-EXP12. Table 1-3 lists specifications for the CH-EXP4.

Table 1-2. CH-EXP12 Specifications

Feature	Attribute	Specification
Chassis	Construction	16 Gauge (.059) cold rolled steel, zinc plated
	Front panel	0.125" aluminum alloy, clear anodized
	Paint	Base: Poly primer per MIL-P-23377; Finish: Semi-gloss black, per Fed-Std. 595B, color 27038 per MIL-Spec TGE529B
	Cooling	Card Cage Area: Two 80 CFM, 5¼" fans, and removable air filter; Power Supply Module: one 40 CFM, 3½" fan
	Switches	Front Panel: Power On, System Reset and Key Lock; Rear Panel: Input Voltage Range
	Indicators	Front Panel: Power On and HD1/HD2 Activity; Backplane: ±5 V/ ±12 V Power Good
	Connectors	Front and Rear Panels: 1 Keyboard 5 pin DIN; Rear Panel: IEC power
	Speaker	8 Ω, 2-inch
	Drive Capacity	Two half-height 5¼" drive bays and two 3½" drive bays all securely mounted with vibration and shock isolators
	Backplane	14 AT slots (16 bit) on 0.800" centers; four-layer construction with power and ground planes
	Weight	33 lbs (15 Kg); Shipping: 41 lbs (18.6 Kg)
Dimensions	7" H x 19" W x 17" D (177.8 mm x 482.6 mm x 431.8 mm)	

Table 1-2. CH-EXP12 Specifications (cont.)

Feature	Attribute	Specification	
Power supply	Output Power	300 W Continuous	
	Output Voltage	Load Current	
		Maximum	² Minimum
	+5 VDC	30 A	2.5 A
	-5 VDC	0.5 A	0.0 A
	+12 VDC	12 A	1.0 A
	-12 VDC	0.5 A	0.0 A
	Input Voltage	90 to 135 VAC / 180 to 265 VAC switch selectable, 47 to 63 Hz	
	AC Input Current	6.3 A Maximum @ 90 VAC, 3.1 A Maximum @ 180 VAC	
	Inrush Current	70 A Maximum (cold start)	
	Hold-Up Time	20 ms Minimum	
	Efficiency	70% Minimum @ full load, 115 VAC line input	
	Overvoltage Protection	+5/+12 V: Automatic shutdown if output reaches 110-130% of rated voltages	
	Short-Circuit Protection	Automatic shutdown if any output is shorted	
MTBF (Mean Time Between Failures)	40,000 hours		
Internal Fuse	6.3 A, 250 V, 3AG, Fast Blow (not user replaceable)		
Safety Approvals	UL1950 Dev.3, CSA 22.2, TÜV EN60950		
EMC/EMI	Meets FCC Class "B", CISPR		

Table 1-2. CH-EXP12 Specifications (cont.)

Feature	Attribute	Specification
Operating Environment	Operating Temperature	0 to +50° C
	Storage Temperature	-40 to 70° C
	Humidity	10 to 85% Relative Humidity at 40° C, non-condensing
	Operation Burn-in	48 hours

Notes

- ¹ A 5-pin ribbon cable is provided for attaching the rear panel keyboard connector to a CPU card.
- ² A minimum load is required for the power supply to operate. Refer to “Board Installation” on page 2-2.

Table 1-3. CH-EXP4 Specifications

Feature	Attribute	Specification	
Chassis	Construction	16 Gauge (0.059) cold rolled steel, acid etched	
	Paint	Gloss Polane, Medium Pebble (Gray), per Fed-Std. 595 # 26081	
	Cooling	One 42 CFM, 3½" fan	
	Switches	Front Panel: System Reset; Rear Panel: Power On	
	Indicators	Front Panel: Power and HD Activity	
	Connectors	Rear Panel: Keyboard 5-pin DIN connector & IEC Power	
	Speaker	8 Ω	
	Drive Capacity	One 3½" floppy and one 3½" hard-disk drive	
	Backplane	6 AT slots (16 bit) on 0.800" centers; two-layer construction with passive AC termination	
	Weight	6 lbs (2.7 Kg); Shipping: 10 lbs (4.5Kg)	
	Dimensions	8.88" H x 7.19" W x 16.13" D (225 mm x 183 mm x 410 mm)	
Power Supply	Output Power	65 W	
	Output Voltage	Load Current	
		¹ Maximum	² Minimum
	+5 VDC	10 A	0.5 A
	-5 VDC	1 A	0.0 A
	+12 VDC	4 A	0.2 A
-12 VDC	1 A	0.0 A	

Table 1-3. CH-EXP4 Specifications (cont.)

Feature	Attribute	Specification
Power Supply (cont.)	Input Voltage	90 to 260 VAC Auto-Sensing, 47 to 63 Hz
	Inrush Current	15 A at 115 VAC, 30 A at 230 VAC
	Hold-Up Time	(115V)16 ms
	Efficiency	75% Typical
	Oversvoltage Protection	Crowbar type; trip point 6.2 V \pm 0.4 V or rated output +2 V
	Overload Protection	Current foldback at 150% of full load
	Short Circuit Protection	Pulse by pulse current limiting
	MTBF (Mean Time Between Failures)	40,000 hours
	Internal Fuse	3.0 A, 250 V, 3AG Fast Blow
	Safety Approvals	UL1950, CSA 22.2, VDE 0806
	EMC/EMI	Meets VDE/FCC Class "B"
Operating Environment	Operating Temperature	0 to +55°C
	Storage Temperature	-20 to 60°C
	Humidity	5 to 95% Relative Humidity, non-condensing
	Operation Burn-in	48 hours

Notes

¹ Each output is able to provide up to the maximum load. However, the total output cannot exceed 65 W continuous.

² A minimum load is required for the power supply to operate. Refer to "Board Installation" on page 2-2.

2

Installation

This chapter describes how to mount the CH-EXP12 expansion chassis in a rack and how to install boards in the chassis.

For detailed installation procedures about any third-party accessories, including disk drives and CPU boards, please refer to the manufacturer's instructions supplied with those accessories.

Rack Mounting

To install the CH-EXP12 into a 19-inch equipment rack, bolt the chassis via the four front-panel mounting holes shown in Figure 2-1. These holes use RTMA standard spacing. The CH-EXP12 requires 7 inches of vertical space in any standard equipment rack.

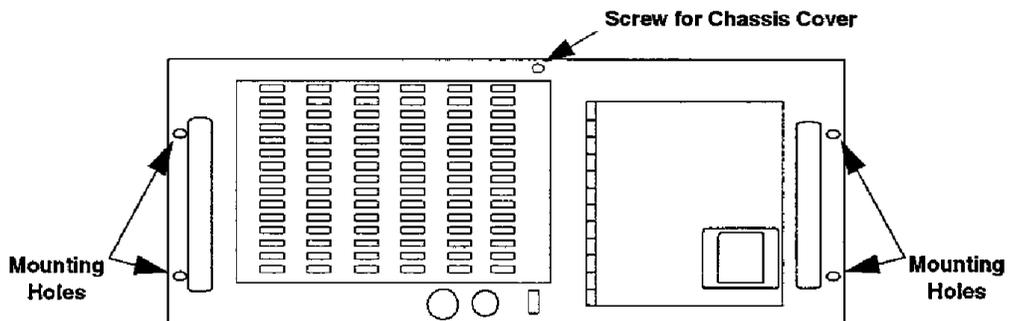


Figure 2-1. CH-EXP12: Front-Panel Mounting Holes

The RTMA standard hole spacing pattern is shown in Figure 2-2.

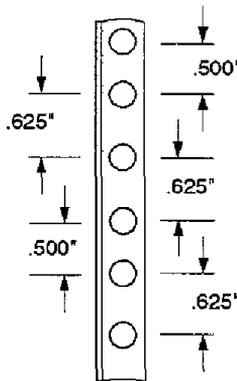


Figure 2-2. RTMA Hole Spacing

Board Installation

When installing accessories or working on any model of the expansion chassis, observe the following procedures and precautions:

1. Make certain that the expansion chassis and PC are turned off. You can leave the power plugs connected to maintain chassis grounding.

Caution: Never insert or remove boards with power on.

2. Remove the top cover from the expansion chassis. Note that to remove the cover, you must remove the screw in the front panel, shown in Figure 2-1, as well as the screws on the side of the chassis.
3. Touch the sheet metal of the expansion chassis to ground yourself and eliminate any static charge.
4. Do your intended installation or work. For detailed installation procedures on the Expansion Chassis Interface Kit, refer to Chapter 3. For all other boards, refer to specific instructions supplied with the boards.

5. Ensure that any boards installed in the far end slots do not short against the disk drive housing.
6. Replace the cover and check that the 115/230V selector switch (CH-EXP12 only) is set for your local line voltage.

Caution: Damage to the power supply may result if you do not properly set the 115/230V selector switch.

7. Turn the power on to the expansion chassis and then to the host computer.

Notes: Power should be applied to the expansion chassis before or at the same time power is applied to the host computer. To apply power simultaneously, plug both the computer and the expansion chassis into a power strip and apply power using the On/Off switch of the power strip.

In some cases where the host computer is a high speed model, the computer may complete boot up before the power supply on the expansion chassis has come up. This may lock up the computer. In this case, a software routine is needed to initiate a reboot after the expansion chassis power is on. Alternatively, you may press the Reset button.

Do not apply power to an empty expansion chassis. A minimum load is required for the switching power supply to operate. This requirement is generally met by installing one board in the expansion chassis (see Table 1-2 on page 1-7 or Table 1-3 on page 1-10 for information on the power supply load for your expansion chassis model).

3

Expansion Chassis Interface Kit

The Expansion Chassis Interface Kit allows you to expand your AT personal computer system without timing or noise problems. It provides an active bus extension that is hardware and software-transparent between your host computer and the expansion chassis. No modification to existing boards or software is necessary, no configuration switches or any initializing software are required, and no memory or I/O addresses are required. DMA and interrupt modes of operation are fully supported. The interface kit is designed as a true expansion of the 16-bit AT bus.

Active circuits and high speed ICs are used to minimize propagation delays. Also, the multi-layer printed circuit boards are optimized for proper impedance matching between components to avoid spikes and ringing.

You can use the interface kit with 386 and 486 computers as well as 286 computers. However, in some cases it may be necessary to assert a wait state. To avoid the need to modify your software, a wait-state jumper is provided. When the jumper is placed in the WAIT position, one wait state is asserted on read operations only from the expansion chassis. The great majority of computers work acceptably without a wait state when communicating to the expansion chassis.

This chapter describes how to install the interface kit, provides information on restrictions, and lists the specifications of the interface kit.

Installation

The interface kit consists of two boards and a quick-disconnect cable assembly. The transmitter (LT) board plugs into the host computer and the receiver (LR) board plugs into the expansion chassis backplane.

Caution: Static sensitive devices are mounted on the expansion interface boards. Use a grounded wrist strap or other approved ESD device before handling the boards to avoid damage to the boards.

To install the interface kit, proceed as follows:

1. Check that power is off on the host computer and expansion chassis.
2. Remove the covers from the host computer and expansion chassis.
3. Check that the wait-state jumper is in the desired position. The jumper block is on the LT board, immediately adjacent to integrated circuit U29. (The board is shipped configured for zero wait state, that is, with the jumper in the lower position). The majority of applications do not require a wait state.
4. Select an unused board slot in the host computer that is free of obstruction. Do not locate the LT board next to a CPU board.
5. Plug the LT board into the computer slot and secure the mounting bracket. If you are using more than one expansion chassis with the same host computer, plug all of the LT boards into the host.
6. Plug the LR board into the expansion chassis and secure the mounting bracket. For best results, use a slot in the middle of the expansion chassis backplane.
7. Re-install the host computer and expansion chassis covers.
8. Connect the supplied cable between the LT and LR cards. You should hear an audible "click" when the connectors seat properly.
9. Connect the host computer chassis to the expansion chassis with a braided cable secured with screws and star washers at both ends. This ensures a good quality ground connection and improves noise immunity.

10. For the CH-EXP12, check that the 115/230V selector switch (located on the rear of the chassis) is set for your local line voltage.

Caution: Damage to the power supply may result if you fail to set the 115/230V selector switch properly.

11. Apply power first to the expansion chassis and then to the host computer.

Note: Power should be applied to the expansion chassis before or at the same time power is applied to the host computer. To apply power simultaneously, plug both the computer and the expansion chassis into a power strip and apply power using the On/Off switch of the power strip.

In some cases where the host computer is a high speed model, the computer may complete boot up before the power supply on the expansion chassis has come up. This may lock up the computer. In this case, a software routine is needed to initiate a reboot after the expansion chassis power is on. Alternatively, you may press the Reset button.

Do not apply power to an empty expansion chassis. A minimum load is required for the switching power supply to operate. This requirement is generally met by installing one board in the expansion chassis (see Table 1-2 on page 1-7 or Table 1-3 on page 1-10 for information on the power supply load for your expansion chassis model).

Restrictions

Computer resources such as graphics boards can be used in the expansions chassis with some restrictions. For example, Hercules, CGA, EGA, and VGA graphics boards can be used in the expansions chassis, but Super-VGA boards cannot be used in the expansion chassis, because they transfer a large amount of data in a brief period of time, and the ENDXFR* signal (sometimes called ØWS*) is asserted for compressed

write timing. Compression of the transfer time does not leave enough time for propagation through the cables. Therefore, when using a Super-VGA board, ensure that the board is installed in the *host* computer chassis.

Another application that is not supported by the Interface Kit is bus mastering. Multi-processor applications, wherein a "smart" device takes over the bus, are not supported. Examples of this include SCSI and IDE hard-drive interfaces or bus-mastering DSP coprocessors and CD ROM interfaces. These types of devices must be installed in the host computer chassis.

Although the interface kit can function with other expansion chassis, it has only been tested with the CH-EXP Series of expansion chassis.

Specifications

Table 3-1 lists the specifications for the Expansion Chassis Interface Kit.

Table 3-1. Interface Kit Specifications

Features	Specifications
Bus	16-bit AT (286/386/486 and EISA-bus computers), 8.3 MHz (tested up to 11 MHz)
Cable Length	Three feet
Wait State	Jumper selectable for 0 or 1 wait state, asserted in hardware
Power Required	LT: 5 VDC at 1.3 A typical LR: 5 VDC at 1.4 A typical
Dimensions	LT: 6.44" L x 3.9" H seated (164 mm x 100 mm) LR: 6.73" L x 3.9" H seated (171 mm x 100 mm)
Operating Temperature	0 to 60°C
Storage Temperature	-50 to 120°C
Humidity	0 to 90% Relative Humidity, non-condensing

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Maintenance and Repair

This chapter provides information on maintaining and troubleshooting your expansion chassis.

Maintaining the Air Filter

Check the air filter on the CH-EXP12 Expansion Chassis for dust build-up on a regular basis in order to maintain optimum air flow and to prevent overheating; refer to Figure 4-1 for the location of the air filter. Under normal conditions, the filter should last for the life of the chassis.

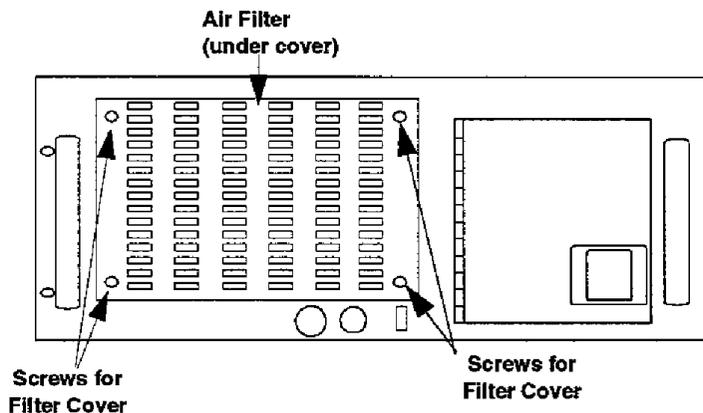


Figure 4-1. Air Filter

To remove the air filter, remove the screws on the front panel that secure the filter cover to the chassis. Clean the filter by washing it in a mild soap and water solution, or blow it clean with compressed air. Replace the filter if it becomes torn or brittle. In particularly dirty environments, use a filter enhancement spray to improve dirt retention. These sprays are available from a variety of utility sources. High efficiency filter material is also available and can be cut to shape. Be careful not to reduce the cooling airflow with excess filter media.

The air filter does not remove fumes or gases. Therefore, do not use the expansion chassis in an environment containing potentially damaging airborne contaminants.

Warning The expansion chassis is not rated for use in explosive environments. You can use the expansion chassis in explosive environments only if it is appropriately enclosed. Refer to the NEMA standards for the enclosure appropriate to your type of environment.

Generally, dust poses no danger to a computer except for disk drives. The exception is electrically conductive dust such as metal or carbon particles. In particularly dirty environments, floppy drive life spans can be significantly reduced. Such environments may call for solid-state cartridges. Use solid-state cartridges in place of floppy disks for portability. You can also use networks in dirty environments to replace floppy drives.

Troubleshooting

Should a failure occur, use the following troubleshooting procedures. Since the components of a computer are largely interrelated, a problem appearing in one component may actually be caused by some other component. For example, a "video" problem may originate in the disk controller. The simplest diagnostic technique calls for replacing the suspect board with a new one. If the problem persists, remove all boards except for the minimum required by the system. Then, run the system, replacing each board until you locate the problem.

A generalized repair guide covering all possible computer problems is beyond the scope of this manual. Only problems directly related to the CH-EXP are covered in the following sections.

Warning Some of the following procedures involve working with 110 VAC or 220 VAC. Accidental shorting of circuits can damage the computer, while contact with this voltage can kill or seriously injure you.

If Unit Does Not Power Up when Switched On

Follow this procedure:

1. Check that the power cord is completely plugged in and that power is available at the source.
2. Check that the 115/230V selector switch (CH-EXP12 only) is set properly for your local line voltage.
3. Check that the front power switch is on.
4. Check that at least one board is plugged into the backplane.

Note: The power supply requires a minimum load to operate (see Table 1-2 on page 1-7 or Table 1-3 on page 1-10 for the power supply specifications appropriate to your expansion chassis). If this requirement is not met, the chassis may power up momentarily, then automatically shut down to prevent damage to the power supply.

If an LED on the Backplane Does Not Light

Follow this procedure:

1. Check the actual voltage at one of the I/O connectors.

Caution: Be very careful when probing the I/O connectors. Do not short across the connector pins; if the supply pins are shorted to a signal pin, the board could be damaged. In addition, do not bend the pin in the connector with your probe tip. This damage is not covered by the warranty.

2. Test the resistance across the resistor. If open, then replace the resistor. Otherwise, replace the LED.
3. Test for the voltage at the power supply connector. If voltage is present at the power connector, but not at the I/O connector, then the backplane is faulty. Otherwise, the supply wiring has an open circuit or the power supply is faulty.
4. If the power supply output is not present, disconnect the appropriate lead from the power supply.
5. Test for the voltage. If voltage is present, then a short exists in the supply wiring, backplane or I/O. If voltage is not present, the power supply is faulty.

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Factory Return Information

Before returning any equipment for repair, please call notify the Application Engineering Department. If possible, an applications engineer will diagnose and resolve your problem by telephone. If a telephone resolution is not possible, the applications engineer will issue you a Return Material Authorization (RMA) number and ask you to return the equipment. Please reference the RMA number in any documentation regarding the equipment and on the outside of the shipping container.

Note that if you are submitting your equipment for repair under warranty, you must furnish the invoice number and date of purchase.

When returning equipment for repair, please include the following information:

- Your name, address, and telephone number.
- The invoice number and date of equipment purchase.
- A description of the problem or its symptoms.

Repackage the equipment. Be careful to avoid electrostatic discharge; use the original anti-static wrapping, if possible.

Specifications are subject to change without notice.

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