



*808 Gilman Street    Berkeley, CA 94710    phone 925.253.2960*  
E-mail: [support@ultraviewcorp.com](mailto:support@ultraviewcorp.com)    Visit us at: [www.ultraviewcorp.com](http://www.ultraviewcorp.com)

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## **PCIeEXT-16HOT**

**Smart Live Insertion PCI-Express Bus Extender**

## **PCIEXT-64U / UB**

**Live Insertion 32/64-Bit Universal 5/3.3v  
PCI Bus Extender**

With software for Windows 7, 8, Vista, XP, 2K, 98, 95

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# **Product Specifications and User Manual**

v1r11-September 17, 2020





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**WARNING! EMPLOY ESD PROTECTION MEASURES AT ALL TIMES WHEN USING EXTENDER BOARDS. FAILURE TO DO SO MAY DAMAGE BOARD UNDER TEST AND EXTENDER.**





## LIMITED WARRANTY

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Ultraview Corporation hardware products are warranted against defects in materials and workmanship for a period of two (2) years from the date of shipment of the product. During the warranty period, Ultraview Corporation shall, at its option, either repair or replace hardware, software or firmware products which prove to be defective. This limited warranty does not cover wear on the top PCI connector and damage caused by misuse or abuse by customer, and specifically excludes damage caused by the application of excessive voltages or currents to any part of the board. Also specifically excluded is ESD damage to the bus switches, so all users are advised to use wrist straps and other ESD protection while inserting or removing boards in any system.

While Ultraview Corporation hardware, software and firmware products are designed to function in a reliable manner, Ultraview Corporation does not warrant that the operation of the hardware, software or firmware products will be uninterrupted or error free. Ultraview products are not intended to be used as critical components in life support systems, aircraft, military systems or other systems whose failure to perform can reasonably be expected to cause significant injury to humans. Ultraview expressly disclaims liability for loss of profits and other consequential damages caused by the failure of any product which would cause interruption of work or loss of profits, such as shipboard or military attachment.

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Some states do not allow the exclusion or limitation on incidental or consequential damages, so the above limitation and exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

# INTRODUCTION

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## SUMMARY

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Ultraview's line of live ("hot") insertion extenders allow rapid production testing and engineering debug of PCI/PCIe add-in cards. The live insertion feature allows an add-in card (UUT) to be turned off, removed, modified or replaced with other add-in cards of the same type, and retested, all without turning off the system power or rebooting the system.

A slot power switch allows power to the UUT to be turned off, allowing removing and replacing UUT without system shutdown or reboot. The UUT is held in power-on-reset until power reaches proper level and host RESET is inactive. Supplied live insertion software allows the user to save and restore UUT's configuration space, for quick board swapping without system shutdown or reboot.

## MODEL: PCIeEXT-16HOT

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The PCIeEXT-16HOT is a live insertion 16 lane PCI Express (PCIe) bus extender card supporting x16, x8, x4, x2 and x1 PCIe cards and is also compatible with PCIe3.0, 2.0 and 1.0 (GEN3, 2 and 1) environments. PCIe signal integrity requirements are met with high-speed trace layout parameters (controlled high impedance and low ground inductance).

The PCIeEXT-16HOT offers power monitoring and over-current indication and limiting, facilitating rapid troubleshooting and testing, and helping protect the host system from damage due to certain UUT malfunctions. Additionally, it offers switch-selectable voltage margining, enabling UUTs to be tested with supply voltages decreased by 0%, 5% or 10%, to expose marginal UUT designs.

## MODEL: PCI-EXT64U / UB

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The PCI-EXT64U and PCIEXT64UB are high-speed 32/64 Bit PCI Bus Extender Cards with switchable bus isolation switches supporting 32 and 64 bit PCI add-in cards, as well as 32 or 64 bit motherboard slots, operating in 5V or 3.3V signaling environments. PCI signal integrity requirements are met with high-speed trace layout parameters (controlled high impedance and low ground inductance) and active bus switching with low capacitance and delay to insure minimal effect on the UUT.

Power monitoring and current limiting provide a robust debug and test environment. The PCIEXT64U/UB's power limiting and overload-disconnect help protect the host system from damage due to certain malfunctions on the UUT.

The PCIEXT64U/UB have test point header arrays, with all host PCI signals, for logic analyzer hookup or piggyback connection.

The PCIEXT64UB has a more rugged, keyed connector than the PCIETX64U, and is recommended for all uses except those in which 3V-only boards-under-test need to be tested.

## FEATURES

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### PCIeEXT-16HOT:

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- > Lubricated connector for thousands of insertions.
- > Allows testing of x16, x8, x4, x2 and x1 add-in cards.
- > Compatible with PCIe3.0, 2.0 and 1.0 (GEN3, 2 and 1) environments.
- > Controlled-Impedance traces for all high-speed signals.
- > Test points with 1V/A outputs indicate current consumption of UUT on 12 Volt, 3.3 Volt, and 3.3Vaux supplies.
- > Two Green LEDs indicate presence of +12V and +3.3V power.
- > Two red LEDs indicate overcurrent on +12V and combined +3.3V and +3.3AUX supplies.
- > Voltage Margining.
- > Controlled Power-On Slew Rate.
- > Current limiting prevents most damage on +12, +3.3, +3.3AUX supplies.
- > Installing a jumper at M1 causes the +12 and +3.3V supplies to ramp up more slowly over a 300us period, to limit inrush current, when Slot Power Switch is turned on.

### PCIEXT-64U / UB:

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- > 5 Volt, 3.3V and VIO Power LEDs
- > 32 or 64 Bit PCI Slot and UUT capacity
- > Usable in 5V or 3.3V PCI bus slots, and with Universal (5/3.3V) or 5V-only UUTs. (The PCIEXT-64U is also usable with 3.3V-only UUTs.)
- > Slot Power ON/OFF switch, Bus-Switches, Power Monitoring Test Points.
- > Test points with 1V/A outputs indicate current consumption of UUT on +5V, +3.3V, and VIO.
- > Current limiting prevents most damage on +12, +3.3, +3.3AUX supplies.
- > Selectable power limit switch with 15, 25 and 35 watt cutoff values, and overload LED.

# INSTALLATION

## PCIeEXT-16HOT:

To install the PCIe extender, power down the host computer and install the PCIeEXT-16HOT into a x16 PCIe slot on the motherboard. Properly secure the extender by installing a retention screw through the metal bracket into the host system, and engage the retention mechanism (if present). For proper operation, the PCIeEXT-16HOT must be installed in a PCIe slot with all voltages (+12, +3.3, +3.3aux) present.

After insuring that the computer is operating correctly, power down the computer and plug in a known good UUT into top of the extender card. Repeat the power-up process with the Slot Power switch in the ON position and the voltage margining switch set to “NONE” to verify that the UUT is functioning correctly. After installation of the PCIeEXT-16HOT and the UUT operation has been verified, the live insertion capability can be used. Refer to the section “LIVE (HOT) INSERTION” before proceeding further, the UUT configuration space will not be re-loaded on insertion of a new UUT unless you use the supplied live insertion software.

## PCIEXT-64U / UB:

To install the PCI extender, power down the host computer and install the PCIEXT64U/UB into a PCI slot. Secure the extender using a screw in the metal bracket. Power up the host computer. Note that for proper operation all PCI voltages (+5, +3.3, VIO, +12 and -12V) must be present.

After insuring that the computer is operating correctly, power down the computer and plug in a known good UUT into top of the extender card. Repeat the power-up process with the Slot Power switch in the on position to verify that the UUT is functioning correctly. After installation of the PCIEXT64 and the UUT operation has been verified, the live insertion capability can be used. Refer to the section “LIVE (HOT) INSERTION” before proceeding further, the UUT configuration space will not be re-loaded on insertion of a new UUT unless you use the supplied live insertion software.



**DO NOT INSTALL THE +12V and -12V ENABLE JUMPERS ON THE PCIEXT64U/UB UNLESS YOUR UUT REQUIRES +/-12V (VERY FEW PCI BOARDS DO).** This will greatly reduce the chances of damaging the bus switches U1 or U2 if you inadvertently plug in your UUT without first turning off Slot Power. Such damage to Bus switches is not covered by the warranty.



**DO NOT INSTALL BOARD-UNDER-TEST THAT HAS DIFFERENT SIGNALLING ENVIRONMENT VOLTAGE THEN MOTHERBOARD SLOT.**

While the PCIEXT64U/UB has been designed to minimize the chance of damage due to incompatible signaling environments between motherboard and board-under-test, any Universal Extender, even the PCIEXT64U/UB, can cause a hazardous situation if the board-under-test that is installed on the extender is designed for a different signaling environment than the PCI motherboard slot that the extender is plugged in to. For example, if the PCIEXT64U/UB is plugged into a PCI bus slot in the backplane that has a 3V signaling environment, the board-under-test **MUST** also be designed to use a 3V signaling environment, or alternatively it may be a universal board. This can be determined by examining the position of the cutouts in the gold finger regions of the board-under-test.

If the PCIEXT64U/UB is plugged into a motherboard slot that has a 5V signaling environment, the “LIKELY SIG. ENV 5V” LED on the extender should light up. In this case, you may only plug in either a board-under-test designed for a 5V signaling environment or a universal board-under-test. The PCIEXT64UB’s PCI connector prevents a 3.3V-only board from being inserted, and the connector’s web ensures correct socket alignment, even with UUTs with out-of-spec gold finger contact areas. It only allows a 5V or Universal (3.3V and 5V capable) board to be inserted. In the rare case that you have a 3.3V-only board-under-test, the Ultraview PCIEXT64U must be used, but that model is not recommended for most high-volume applications, due to the ability for some boards-under-test to be installed in a misaligned manner.

If the PCIEXT64U or UB is plugged into a motherboard slot that has a 3V signaling environment, the “LIKELY SIG ENV 3V” LED should light up. In this case, you may only plug in either a board-under-test designed for a 3V signaling environment, or a universal UUT. In rare cases you may be also able to insert a board with 5V signaling environment (despite the PCIEXT64U or UB being installed in a 3V slot), but only in cases in which you can be absolutely sure that the board-under-test does not use VIO internally, and does not connect it to any other power supply plane. Even in that case, there is a risk of damaging the board-under-test, so this should only be tried with prototype boards that are expendable.

### **External Power: (Optional and Risky)**

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#### **- USE EXTREME CAUTION! -**

**Slot Power switch must remain in OFF position, and computer system must remain ON, when using this mode or damage to system may result.**

An external power supply can be used to provide the plug-in UUT power by use of the 5V, +/- 12V, VIO and 3.3V test point connectors. The Slot Power switch **MUST** remain off when an external power supply is connected to power points. Special care must be taken with an external power supply, as power provided to the plug-in UUT is not current limited. Also, if the external +5V (and +3V if used) are below +4.75V and +2.7V respectively, the bus switches will not turn on, and the UUT will not be accessible to the system. While the use of an external power supply is valuable for voltage margin testing of UUTs, it must be done with care. Use a multi-output external power supply whose voltages all turn on and off as close to simultaneously as possible. Before removing the UUT, be sure to save the UUT’s configuration registers using the live-insertion software, and then turn off the external power supply. The computer must remain ON. The bus switches on the PCIEXT64U or UB will automatically disconnect the UUT from the motherboard when the external 5V (and 3.3V, if present) fall below the 4.7V and 2.7V thresholds, respectively. Then, remove your UUT, and replace it with another, just as you would do normally. When you are ready to start up your new UUT, turn on the external power supply (not the slot power switch). Then, reinitialize the configuration registers, using the live insertion software, and begin to use the new UUT.

**Remember that the SLOT POWER switch on the PCIEXT64U or UB must always remain off when using external power. It must never be turned on!**



## LIVE (HOT) INSERTION

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**WARNING! NEVER INSERT OR REMOVE A UUT WITH THE SLOT POWER SWITCH IN THE ON POSITION!**

The live insertion capability is enabled by first saving the UUT's configuration space contents, using the live insertion software. Once the UUT configuration space has been saved live insertion can be performed by turning the Slot Power switch off, removing the UUT and inserting a new UUT of the same type and then turning the Slot Power switch on. All of this can be done without the need to power the host system off.

After the Slot Power switch is turned on the UUT configuration space contents must be restored before the UUT is accessed. The restoration of the configuration space is performed using the live insertion software described in the following section.

### **EXTERNAL CONTROL OF UUT POWER PCIe-EXT16HOT**

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The Slot Power can be externally controlled via a software driven parallel port signal, or other TTL control signal, by simply driving the bottom connection (bottom terminal) of the Slot Power switch. A HIGH level on this signal will turn the slot power on, a LOW level will turn it off. The mechanical SLOT POWER switch must be left in the OFF position for the external signal input to work properly.

### **EXTERNAL CONTROL OF UUT POWER PCI-EXT64U / UB**

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You may control the Slot Power via a software driven parallel port signal, or other TTL control signal, by simply installing a small N-channel FET (such as BS170) as shown in the photo on the previous page. The FET's source terminal should be connected to the ground connection (left terminal of switch) and the drain terminal connected to the center connection (center terminal of switch). The TTL control signal should be applied to the gate terminal of the FET – a HIGH level on this signal will turn the slot power on, a LOW level will turn it off. The mechanical SLOT POWER switch must be left in the OFF position for the external FET to work properly.

You may also use the PCIEXT64U/UB to apply switchable power to the UUT without turning on the bus switches. This is done by installing the "DISABLE BUS SWITCHES ALWAYS" jumper. This feature is useful for avoiding system crashes while programming FPGAs on the UUT, although the system cannot communicate with the UUT with this jumper in place.

# LIVE INSERTION SOFTWARE

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## INSTALLING GUI-BASED SOFTWARE UNDER 32-BIT WINDOWS 7/VISTA/XP™

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Live insertion software may be downloaded from:

<http://www.ultraviewcorp.com/downloads>

The GUI-based live-insertion software allows the UUT configuration register values to be saved after the first UUT is inserted into the extender, and then to be re-initialized after the UUT board is replaced with an identical type of board.

1. Download the GUI-based version of the live insertion software for 32-Bit Windows 7/VISTA/XP™ operating systems. Extract the downloaded archive file to a convenient location on your system, insuring that the resulting .exe and .sys files remain in the same directory.
2. Perform a test run of the software by running “Pcint”. If the program does not run, you may have to reboot the system, and then right-click on the “Pcint” icon and click on “Run as Administrator” the first time you use it. On Windows Vista, right click on the “Pcint” icon, then click on “Properties”, then click on “Compatibility”, then click on “Privilege level”, then click on “Run this program as an administrator”, and then click “OK”. Thereafter, you should not need to take this extra step.

**NOTE:** If you find that PCINT.exe does not enable successful usage of your board after live insertion, install the command line extended configuration space version of the live insertion software.

## USING GUI-BASED SOFTWARE UNDER 32-BIT WINDOWS 7/VISTA/XP™

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When PCINT.EXE starts up, you will see a window entitled “PCI Device List” with a list of PCI/PCIe devices in it. If there are 8 PCI or PCIe devices in your system, you will see eight items on the list. Not all of these PCI/PCIe devices are add-in cards, some are motherboard PCI chips. One of these devices is the UUT.

You will need to find out which of these devices is the UUT, you may be able to recognize it by its description. Double click on the name of one of the listed devices. A new window entitled “Edit PCI Configuration Space” will appear which displays the first 16 configuration registers of that PCI or PCIe device. The first register in each window (register 0) is the vendor ID number. Verify that the vendor ID you see is the correct one for your UUT. If you do not know the vendor ID of your UUT, ask the UUT manufacturer. If the vendor ID you see does not match the one known to be for your UUT, exit this window by clicking on OK, and then get back to the list by clicking on File and then clicking on Probe PCI List. Then select a different board, and verify that it displays the vendor ID known to be correct for your UUT.

A detailed description of each register’s function is contained in the PCI or PCIe Bus Specification, although for most production applications, it is not necessary to note the contents of these registers. The contents of these registers are saved so that the user can power off and remove the UUT and then later restore these contents when inserting a new UUT (of the same type as the one removed). Once you are in the correct window (entitled “Edit PCI Configuration Space”) for your UUT, the

contents you see of the first 16 configuration registers of your UUT have already been saved, and you can now turn off the slot power for your UUT, remove the UUT and replace it with another UUT.

Then, turn the slot power on and restore the new UUT's registers by clicking on "Write to Device" and then clicking "OK" in the Write Confirmation window.

Your new UUT should now be accessible to the system in the same manner as the old one was.

You may test multiple identical UUTs without having to save the registers each time. Just turn OFF the slot power switch, plug in the new UUT, turn ON the slot power switch and click on Write to Device and then "OK" in the Write Confirmation menu, to initialize each newly inserted device.

Saving UUT configuration registers to disk is only necessary if you will be exiting the PCINT.EXE program before you swap UUTs. You may optionally save UUT configuration register contents to disk (after first clicking on Probe PCI List and selecting your UUT from the list), by leaving the "Edit PCI Configuration Space" window, clicking on OK, then clicking on File and then "Save as". Then, type in a file to store the configuration data to.

Any configuration setup previously saved to disk may be recalled by clicking "File", then "Open" and then selecting the name of the file in which you had originally stored your data. A device list should appear. Click on the device name for your board. The "Edit PCI Configuration Space" window will appear. Verify that the Vendor ID is the correct one for your UUT and then click on "Write to Device". If you reboot your system, do not restore configuration register contents to a new UUT from the saved file, as the registers are not always configured with the same base address and other contents on each boot-up. Each time you boot up a system, you must freshly save the UUT's configuration registers, and use this new information to restore the registers on subsequent insertions of the same type of UUT in that slot.

You may also use PCINT.EXE to manually edit config registers of any PCI device, although this should only be done for debugging purposes. The contents of any writable registers may be modified by clicking on the desired field, typing in new contents, and clicking on "Write to Device", to send the modified data to the UUT.

**Every time the system is re-booted, you must have your UUT installed in the extender and the slot power switch turned ON for correct live insertion operation.**



## INSTALLING COMMAND LINE SOFTWARE UNDER 32-BIT or 64-BIT WINDOWS 7/VISTA/XP™

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Live insertion software may be downloaded from:

<http://www.ultraviewcorp.com/downloads>

This command line based live insertion software is designed to access the PCI configuration space of both PCI and PCIe boards in 32 and 64 bit systems. **This software does NOT currently support access to extended configuration space.**

1. Download the command line live insertion software for 7/VISTA/XP™ operating systems. Extract the downloaded archive file to a convenient location on your system.
2. Open a Command Prompt (START > ALL PROGRAMS > ACCESSORIES > COMMAND PROMPT). You may need to run the Command Prompt as administrator. Change directory to the directory containing the extracted files.
3. Change directory to the folder labeled with your system type. For 64-bit systems, navigate into the 64bit directory, and for 32-bit systems, navigate into the 32bit directory.
4. Typing “liveinsert” will show the usage cases of the program.

**NOTE: The Ultraview Live Insertion software now (03/06/2013) uses a signed driver.** If an old driver is being used, depending on your system type and security settings, it may be necessary to disable driver signature enforcement. In order to do this in most Windows™ systems, press the F8 key as Windows™ is booting. This should bring up the “Advanced Boot Options” screen. Use the arrow keys to move down to the “Disable Driver Signature Enforcement” option, and press ENTER. This option allows the Ultraview driver to load successfully, and the above procedure must be followed on every system boot.

## USING COMMAND LINE SOFTWARE UNDER 32-BIT or 64-BIT WINDOWS 7/VISTA/XP™

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To use the live insertion software, **be sure that a UUT has been installed on the extender and that the slot power switch was in the ON position prior power-up.** To save the configuration space contents prior to UUT removal and installation of a new UUT, run LiveInsert in Save Mode by typing “liveinsert -s”. A list of PCIe and PCI devices detected in the system will appear, similar to that shown below (you may need to stretch the bottom of the window downward to see all of the devices):

Saving Configuration Space.

Writing or Saving Configuration space may result in system instability

This may take a minute.....

32 Devices Found

-----DEVICE LIST-----

Dev#=00 VendorID= 104c DeviceID= 8024

Dev#=01 VendorID= 10ec DeviceID= 8168

..

..

..

Dev#=30 VendorID= 8086 DeviceID= 2e21

Dev#=31 VendorID= 8086 DeviceID= 2e20

Enter Device to Save:

From the list of displayed devices, select your device, by looking at the Vendor and Device Ids (and/or Class codes) in the list and choosing the one that corresponds to your device. For example, in the example program output list above, if the Vendor and Device ID of the board you have installed on the extender are 10ec:8168, you would simply type "1", as follows.

Enter Device to Save: 1

The program would then proceed to read the entire configuration space of the device entered, and save it to "live.dat" in the run directory.

At this point, if you would like to swap boards, do the following:

- 1) Turn the extender Slot Power switch OFF.
- 2) Check that the +12V and +3.3V LEDs on the extender are off! If so, remove board from extender and install a new board *of the same type*
- 3) Turn Slot Power switch ON. The +12V and +3.3V LEDs should come on.
- 4) Type "**liveinsert -w**" in the command prompt to run the live insertion software in write mode. This mode will write the configuration space stored in "live.dat" back to the correct device.
- 5) You may now run your application the way you normally do and it should correctly run the newly inserted board.

The newly installed board is now ready for your user program to access. You may use the board, later uninstall it (be sure to turn slot power switch OFF first), and then replace it with yet another board by repeating steps 1 through 5 above.

Note that this disk file may only be used during the current boot of the system. If the system is re-booted, some of the configuration data written to your board may change. Therefore, on each system reboot, you should make a new disk file, and should not use the pre-existing "live.dat" file.



## INSTALLING SOFTWARE UNDER LINUX

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Live insertion software may be downloaded from:

<http://www.ultraviewcorp.com/downloads>

This command line based live insertion software is designed to access both the standard PCI/PCIe configuration space, and the extended space that also must be rewritten when live-inserting some PCIe boards.

5. Download the live insertion software for Linux operating systems. Extract the downloaded archive file to a convenient location on your system. The archive contains a pre-compiled executable and a .zip file containing the source code for rebuilding the application (typically not required).
6. Log on as “root”, open a terminal window, and change directory to the directory containing the extracted files.
7. Perform a test run of the software by typing “./live”. If the program does not run, you may need to rebuild the executable. The current Linux live insertion software has been tested on Redhat 5 and Centos 5.

## USING THE LIVE INSERTION SOFTWARE UNDER LINUX

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To use the live insertion software, **be sure that a UUT has been installed on the extender and that the slot power switch was in the ON position prior power-up.** To save the configuration space contents prior to UUT removal and installation of a new UUT, run ./live from a terminal window, as shown below. A list of the PCIe and PCI devices detected in the system will appear, similar to that shown below (you may need to stretch the bottom of the window downward to see all of the devices):

```
[root@localhost liveins]# ./live
```

A list of the PCI and PCI-Express devices detected in the system will appear as shown below:

```
Device #0 = 00:00.0 Class 0500: Device 10de:0369 (rev a1)
Device #1 = 00:01.0 Class 0601: Device 10de:0360 (rev a2)
Device #2 = 00:01.1 Class 0c05: Device 10de:0368 (rev a2)
Device #3 = 00:02.0 Class 0c03: Device 10de:036c (rev a1)
Device #4 = 00:02.1 Class 0c03: Device 10de:036d (rev a2)
Device #5 = 00:04.0 Class 0101: Device 10de:036e (rev a1)
Device #6 = 00:05.0 Class 0101: Device 10de:037f (rev a2)
Device #7 = 00:05.1 Class 0101: Device 10de:037f (rev a2)
Device #8 = 00:05.2 Class 0101: Device 10de:037f (rev a2)
Device #9 = 00:06.0 Class 0604: Device 10de:0370 (rev a2)
Device #10 = 00:0a.0 Class 0604: Device 10de:0376 (rev a2)
Device #11 = 00:0b.0 Class 0604: Device 10de:0374 (rev a2)
Device #12 = 00:0c.0 Class 0604: Device 10de:0374 (rev a2)
Device #13 = 00:0d.0 Class 0604: Device 10de:0378 (rev a2)
Device #14 = 00:0e.0 Class 0604: Device 10de:0375 (rev a2)
Device #15 = 00:0f.0 Class 0604: Device 10de:0377 (rev a2)
Device #16 = 00:18.0 Class 0600: Device 1022:1100
Device #17 = 00:18.1 Class 0600: Device 1022:1101
Device #18 = 00:18.2 Class 0600: Device 1022:1102
```



```
Device #19 = 00:18.3 Class 0600: Device 1022:1103
Device #20 = 01:05.0 Class 0300: Device 1002:515e (rev 02)
Device #21 = 02:00.0 Class 0604: Device 8086:032c (rev 09)
Device #22 = 04:00.0 Class 0200: Device 14e4:1659 (rev 21)
Device #23 = 05:00.0 Class 0200: Device 14e4:1659 (rev 21)
Device #24 = 08:00.0 Class 1180: Device febd:0065
Enter Device Number:
```

For a more detailed description of the information in the above display, type “man lspci”.

From the list of displayed devices, select your device. This can be done by looking at the Device Ids (and/or Class codes) in the list and choosing the one that corresponds to your device. For example, in the example program output list above, if the **Vendor and Device ID** of the board you have installed on the extender are **febd:0065**, you would simply type “24”, as follows.

```
Enter Device Number: 24
```

The program would then respond as follows:

```
Device Number 24 Selected
```

Next, the program will display the configuration registers for this device (which can generally be ignored), followed by board removal and re-insertion instructions, as shown below:

```
0:  bd    fe    65    0
4:  7     1    10    0
8:  0     0    80    11
c:  10    0     0     0
10: 4     f0    ff    ef
14: 0     0     0     0
.
.
.
70: 0     0     0     0
```

To swap boards, 1) Turn Extender Slot Power switch OFF, 2) Swap board with same type and 3) Turn Slot Power switch ON.

Then Enter 1 to write the previously read configuration data back to device #24:

To swap out the board and install another in its place, you should now:

- 1) Turn OFF the extender's Slot Power switch.
- 2) Remove the UUT, and install a new board of the same type.
- 3) Turn on the extender's Slot Power switch. Then, before running your user program that accesses the newly installed replacement, you must re-instate the configuration space registers by simply typing a “1” at the above prompt.

Then Enter 1 to write the configuration data (previously read) back to device #24:1

The program will respond with:

```
writing configuration data to device #24...
[root@localhost liveins]#
```

The newly installed UUT is now ready for your user program to access. You may use the board, later un-install it, and then replace it with yet another board by repeating the above process. If at any point

when running “live”, you want to quit instead of rewriting the configuration registers, just type “q”.

The above-described live insertion method (typing “1” to restore configuration space to each newly inserted board) should work for most live insertion applications. Optionally, you may store the configuration space data to disk by running the command “live -s” from a command prompt, which will now allow you to exit the program rather than having to keep the program running. You may then later remove the board (be sure the slot power switch is off), and insert another (turning the switch on after it is inserted), and restore the configuration registers in the newly inserted board by typing “live -w” from the command prompt. Note that this disk file may only be used during the current boot of the system. If the system is re-booted, some of the configuration data written to your board may change. Therefore, on each system reboot, you should make a new disk file, and should not use the preexisting live.dat file.

## **USING THE LIVE INSERTION SOFTWARE WITH A UUT THAT CONTAINS A BRIDGE**

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A device with a bridge will have more than one Device # appear when powered on the extender. To verify whether your device has a bridged connection, do the following steps.

- 1) Turn OFF the extender’s Slot Power switch.
- 2) Remove the UUT from the extender.
- 3) Display the list of devices by typing “liveinsert –s” for Windows or “./live” for Linux. Take note of all the device IDs and vendor IDs and number of devices found.
- 4) Shut down the computer. Place the UUT onto the extender. Turn ON the Slot Power Switch. Turn on the computer.
- 5) In the software command prompt, display the list of devices by typing “liveinsert –s” for Windows or “./live” for Linux. If the number of devices found has increased by **more** than one, then the UUT most likely has a bridge.

An example of a bridge Vendor ID: Device ID is 8086:2771  
Where 8086 is the Intel Corp Vendor ID and 2771 is Host to PCI Express Bridge Device ID

If your UUT has any bridge, use the following alternate steps to properly configure for live insertion.

- 1) Install extender card and UUT into PC.
- 2) Apply power to the PC and make sure you can see the UUT listed in the Device Manager window.
- 3) Type in “liveinsert –s” for Windows or “./live” for Linux. A list of PCI devices will be displayed and you will be prompted to enter the device number to save.
- 4) Choose the Device # that corresponds with the Vendor ID and Device ID associated with the



UUT (but not the Vendor ID or Device ID for the bridge on the UUT).

- 5) In the Device Manager window, right-click the entry for the UUT and choose "Disable".
- 6) Turn OFF the extender's Slot Power switch.
- 7) Remove the UUT, and install a new board of the same type.
- 8) Turn ON the extender's Slot Power switch.
- 9) In the command prompt, type "liveinsert -w" in Windows or "1" in Linux.
- 10) In the Device Manager window, right-click the entry for the UUT and choose "Enable".
- 11) Your new UUT should be fully functional and ready to use.

Some customers have reported success with an alternative approach to configuring devices:

- 1) Install extender card and UUT into PC.
- 2) Apply power to the PC and make sure you can see the UUT listed in the Device Manager window.
- 3) Type in "liveinsert -s" for Windows or "./live" for Linux. A list of PCI devices will be displayed and you will be prompted to enter the device number to save.
- 4) Choose the Device # that corresponds with the Vendor ID and Device ID associated with the UUT (but not the Vendor ID or Device ID for the bridge on the UUT).
- 5) Turn OFF the extender's Slot Power switch.
- 6) Open Device Manager and click action->scan for hardware changes.
- 7) Remove the UUT, and install a new board of the same type.
- 8) Turn ON the extender's Slot Power switch.
- 9) In the command prompt, type "liveinsert -w" in Windows or "1" in Linux.
- 10) In the Device Manager window, click action->scan for hardware changes.
- 11) Your new UUT should be fully functional and ready to use.

## CURRENT MEASUREMENT TEST POINTS

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### PCIeEXT-16HOT:

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The PCIeEXT-16HOT allows real-time measurement of power consumption during board operation. A voltmeter or oscilloscope can be connected with its positive (+) lead to either the +12 CURR, +3.3 CURR or +3.3AUX CURR white test points, and its negative (-) lead to the black GND test point. The voltage output on these test points has a 1:1 Volt-to-Ampere correspondence. Hence, a reading of 2.4V on the +3.3 CURR test point indicates that the UUT is drawing 2.4 *amperes* from the +3.3V supply.

### PCIEXT-64U / UB:

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The PCIEXT64U and UB allow real-time measurement of power consumption during board operation. A voltmeter or scope can be connected with its "+" lead to either the 5I, 3.3I or VIO white test points, and its "-" lead to the black GND test point. The voltage output on these test points has a 1:1 Volt-to-Ampere correspondence. Hence, a reading of 2.4V on the 5I test point indicates that the UUT is drawing 2.4 *amperes* from the 5V supply.

The **POWER LIMIT SWITCH** allows selection of a power limit value of 15, 25 or 35 watts. For example, if set to 25W, the PCIEXT64U or UB will limit the +3.3V, +5V and VIO current if the UUT draws more than 25 watts total on its +3.3V, +5V and VIO power pins. **Note that the 35 W setting is above the maximum per-slot power (25 W) allowed by the PCI specification. Also, the +/-12V power is not protected from overloads.**

# PCIEEXT-16HOT ADVANCED FEATURES

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## UNDER-VOLTAGE MARGINING

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**WARNING: UNDERVOLTAGING POWER MAY DAMAGE SOME UUTs OR CAUSE SYSTEM CRASHES. USE AT YOUR OWN RISK.**

The PCIeEXT-16-HOT allows application of reduced versions of +3.3V, +3.3AUX and +12V for the purpose of margin testing the UUT. If the MARGINING switch (top switch in Figure 1) is in the 0% (top) position, no margining will be used, and the voltage fed to the UUT (when the Slot Power switch is ON) will be the full voltage present at the power connections on the motherboard.

If the MARGINING switch is in the 5% (middle) position, the voltage supplied on the +3.3V and +3.3AUX pins to the UUT will be approximately 3.15V. This 3.15V voltage will be output to the UUT even if the motherboard voltage is out of specification, as long as the motherboard voltage is over 3.2V. Similarly, with the MARGINING Switch in the 5% position, the voltage supplied on the 12V pins to the UUT will be approximately 11.4V, regardless of the motherboard voltage on the 12V pins, so long as this voltage is 11.5V or higher.

If the MARGINING switch is in the 10% (bottom) position, the voltage supplied on the +3.3V and +3.3AUX pins to the UUT will be approximately 3.0V. This 3.0V voltage will be output to the UUT even if the motherboard voltage is out of spec, as long as the motherboard voltages are over 3.05V. Similarly, with the MARGINING Switch in the 10% position, the voltage supplied on the 12V pins to the UUT will be approximately 10.8V.

## SLOW POWER SUPPLY RAMP-UP

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The PCIeEXT-16-HOT turns all three power supplies on when the Slot Power switch is turned on, and these voltages rise to full value in approximately 50-100 microseconds. On UUTs with large amounts of bulk capacitance, the resulting inrush current may exceed the host computer's power supply capability, causing the system to reset or hang. For such systems, installing the jumper at the M1 pair will cause the power-un ramp to approximately 600 microseconds.

## IN CASE OF TROUBLE:

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### SYSTEM CRASHES/HANGS WHEN SLOT POWER TURNED ON

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Some PCIe or PCI boards do not come up with all of their PCIe bus lines inactive, as is required by the specification. These boards may not work on live insertion extenders. The PCIeEXT-16-HOT holds RESET to the UUT low until at least 500ms has transpired since all power supply voltages have risen to their full specified values. Then, the PCIe-EXT16-HOT removes the RESET# signal to the UUT. This allows correctly designed PCIe bus boards to operate properly on power-up on our live insertion extender.

If the system hangs or crashes when the slot power switch is turned on, the board-under-test may be driving the bus immediately after its power is brought up (while RESET# is still asserted) which is illegal. One way to remedy the problem is to modify the board-under test.

### SYSTEM RESETS WHEN SLOT POWER SWITCH IS TURNED ON

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The power supplies in some systems have inadequate reserve capacity to handle the inrush current of some boards-under-test when they are switched on in an active extender. This may cause the system's +12V or +3.3V supplies to dip, causing the system to reset. This problem is rare, as the PCIeEXT-16-HOT and PCIEXT-64U / UB have slew-rate limiting circuitry, causing the supplies to the UUT to rise smoothly over a 200 us period, reducing inrush current. If you suspect this problem is occurring, try the PCIeEXT-16-HOT in a different system.

### SYSTEM HANGS AFTER REINSTATING CONFIGURATION SPACE

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Some UUTs use CPLDs or FPGAs that fail to initialize correctly due to the controlled slew power ramping on the PCIeEXT-16-HOT.

### UUT IS NON-RESPONSIVE OR NOT VISIBLE AFTER REINSTATING CONFIGURATION SPACE

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Some PCI/PCIe devices have registers outside the configuration space that must be setup by the device's corresponding device driver before the device can be accessed by user software. These devices require the device driver to be reloaded after the configuration space is re-instated.

Some PCI/PCIe devices have bridges, and if not properly handled, will become non-responsive after reinstating configuration space. See Section USING THE LIVE INSERTION SOFTWARE WITH DEVICES WITH A BRIDGE in order to handle devices that use bridges.

### Open SC Manager failed! Error =5

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This error occurs in the Command Line software when "liveinsert -s" when a Command Prompt is not executed with Administrator privileges. Right-click the Command Prompt icon and select "Run as Administrator".

## Windows 10

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There is no software required for Windows 10.

In order to hot swap under Windows 10, perform the following actions:

- 1) Open device manager (you can type “device manager” in the search menu).
- 2) Find the driver for the device on the extender
- 3) Right click the device driver and select “disable”
- 4) Flip the extender power switch to the off position
- 5) Remove the card from the extender
- 6) Place a similar card onto the extender
- 7) Flip the extender power switch to the on position
- 8) In device manager, right click the device driver and select “enable”

### APPENDIX – DEFEATING THE CURRENT LIMITING AND CURRENT MEASUREMENT FUNCTION

In some cases, when a board-under-test consumes far more current than the PCIe bus specification allows, it will cause the PCIEEXT16-HOT to shut down the power to the board-under-test. If it is necessary to use the board despite this condition, the current measurement (and current limiting) function can be disabled for either the +3.3V or +12V supplies, or both, by soldering a small piece of wire across the shunt resistors for the respective supply for which current limiting is to be disabled, as shown in the figure below:

