

Mirrorcle Technologies, Inc.

MirrorcleTech Micromirror Development Kit

User Guide

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Important Operating Guidelines and Tips:

- The devices are sensitive to electrostatic discharge, always insure adequate grounding when handling the chips. A wrist grounding strap with a 10M Ω series resistance is recommended.
- Many of the devices have anti-reflection (AR) coated windows that should not be directly handled. Any handling of the micromirror chip should be done with care to maintain the AR-coated window as clean as possible. The window can be cleaned with isopropyl alcohol and light rubbing with fine lens-cleaning cloth.
- Some devices may be shipped without AR-coated windows, for better performance with customer-specific lasers, etc. Those devices are most fragile due to the exposed MEMS structures and should be handled with extra care and never touched with any object to the device area, including streams of blowing air and similar disturbances.
- It is recommended that you do not plug-in or un-plug the DAQ cable while the micromirror is connected to the HV amplifier. Please lower voltage settings, set the switch on the micromirror miniPCB to the OFF position, and/or remove the micromirror chip from the ZIF socket, before unplugging the DAQ cable (USB cable if using the USB driver add-on,) or external power supply.
- Always observe the specified maximum voltage levels and angles specified for each delivered mirror on a separate sheet enclosed with your development kit.
- Always perform tests that include any new settings such as new drawings, new refresh rates, new filter settings etc, at LOW voltage settings until you can verify that those settings are working properly and not exciting the device beyond mechanical limits (usually -8° to +8°,) or beyond voltage limits.

Thank you for your interest in MirrorcleTech's Micromirror Development Kit and MEMS technologies. If you have any questions regarding proper setup or use of the development system please do not hesitate to contact us at support@mirrorcletech.com, or at 510-524-8820

STEP 1: After receiving MirrorcleTech's Micromirror Development Kit please check that the following items are included:

Standard development kit:

- **1-Quadrant Device Kit only:** (2) 3-foot SMA cables
- **4-Quadrant Device Kit only:** 3-foot 10-pin ribbon cable
- Laser diode and laser diode power supply (with 2xAA batteries)
- 90° optical mount for laser diode on a ½"-diameter post
- 4.5" x 4.5" optical plate and two 2"-tall post holders
- 2-axis kinematic mount with micromirror miniPCB (24pin or 8pin) on a ½"-diameter post
- Mirrorcle Software Suite installation CD

PCI-Version:

- HV amplifier box with 68-pin DAQ-compatible connector
- External +5VDC power adapter
- 6" Shielded "Y" cable 3.5mm stereo plug (M) to two RCA jacks (F)
- (2) adaptors BNC(F) to RCA(M)

USB Version:

- HV amplifier daughterboard that plugs into NI USB M-series DAQ
- [National Instruments](#) NI-DAQmx software drivers for Windows installation CD
- [National Instruments USB-6221 M-series DAQ](#) with external power adapter
- USB cable

Wide angle lens add-on:

- One additional 2" tall post holder
- Swivel base adapter
- Wide angle lens (0.5" or 1" diameter,) mounted on a 2" long ½"-diameter post

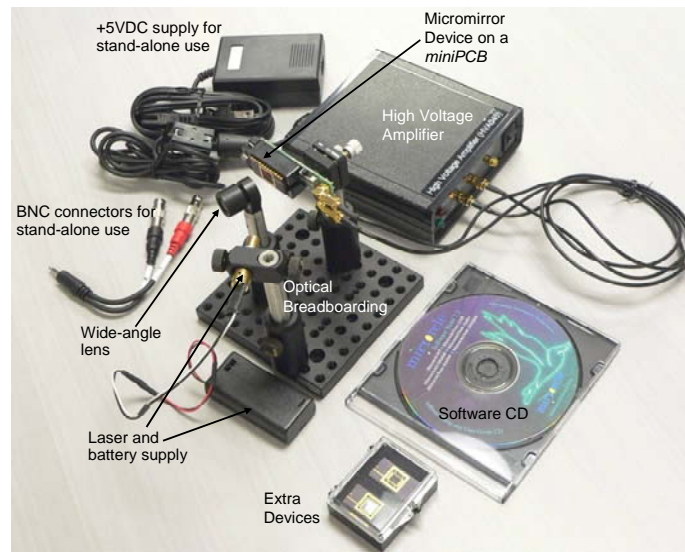


Figure 1. Photograph of a typical 1-quadrant MirrorcleTech development kit – PCI version.

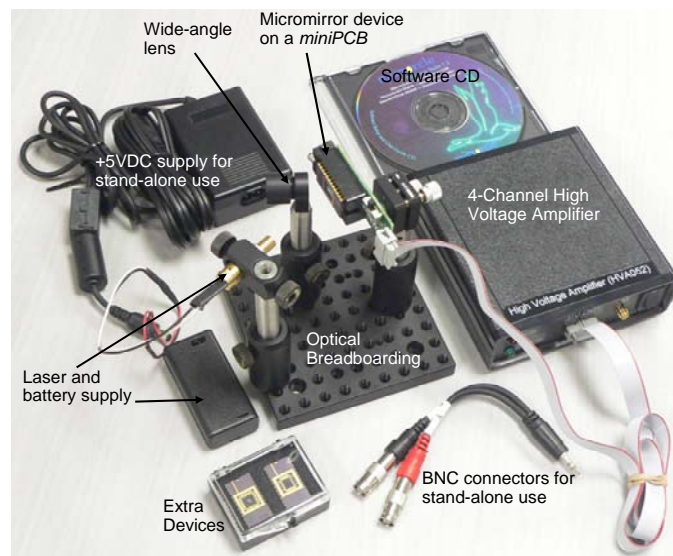


Figure 2. Photograph of a typical 4-quadrant MirrorcleTech development kit – PCI version.

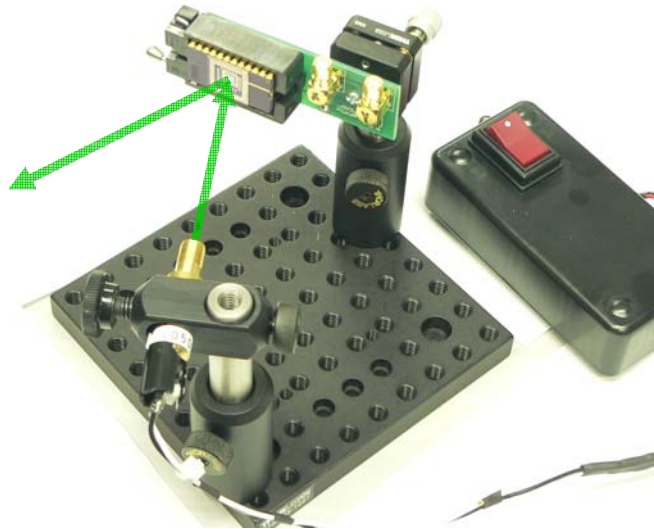
STEP 2: FOR PCI-VERSION: DO NOT INSERT A MIRROR INTO THE ZIF UNTIL STEP 5. Plug the 68 pin shielded cable into the NI-DAQ card installed in the PC to be used to run the Mirrorcle Technologies software and then connect the cable to the HV amplifier box, the green LED on the HV amplifier box should illuminate indicating that power is supplied to the box. The red LED, which indicates that the high voltage supply inside the amplifier is enabled, should be OFF.

STEP 2: FOR USB-VERSION: DO NOT INSERT A MIRROR INTO THE ZIF UNTIL STEP 5. In this step, install drivers from National Instruments DAQmx software for windows 2000/XP/Vista CD. Plug the USB cable into your PC and the USB-6221. Plug the external power adapter for the USB-6221 and turn the back-panel switch ON. Your PC should automatically ask you to install a new device. The drivers for the device should already be installed in step 2 and should automatically complete your installation in this step. The green LED “Ready” on the front of the USB controller should illuminate.

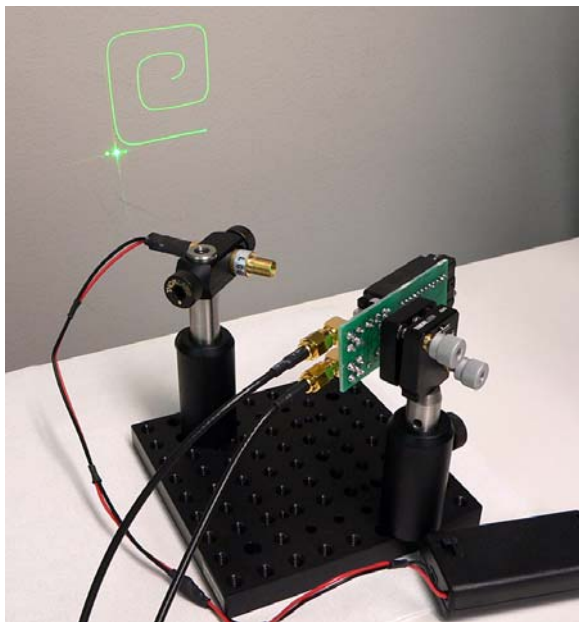
STEP 3: Mirrorcle Software Installation.

Insert the software installation CD from Mirrorcle Technologies, and follow the instructions provided in the README file.

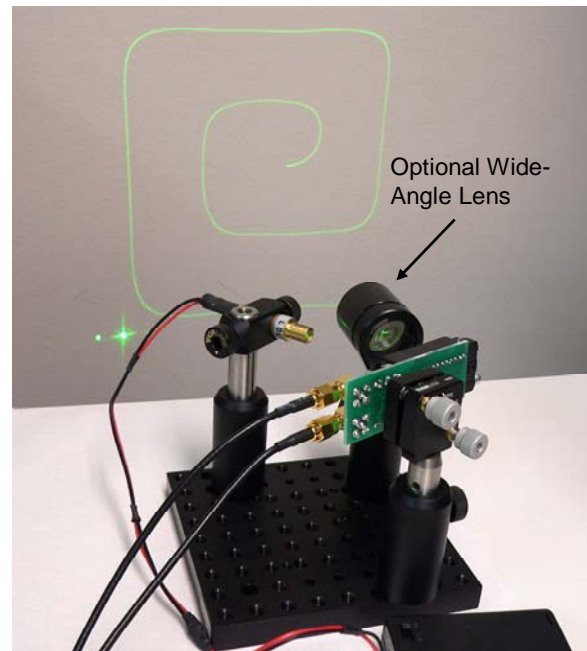
STEP 4: Assemble the optical hardware. If required configure the laser mount, static mirror mount and micromirror mount as shown in the figure on the following page.



Recommended optical setup



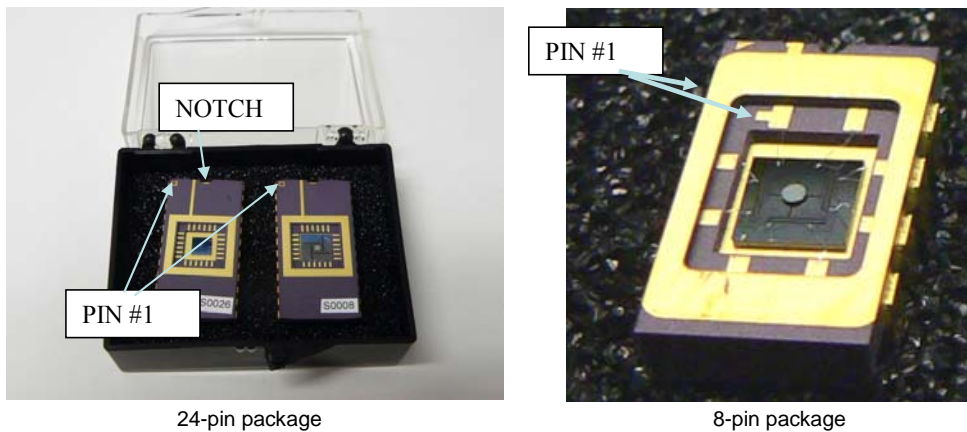
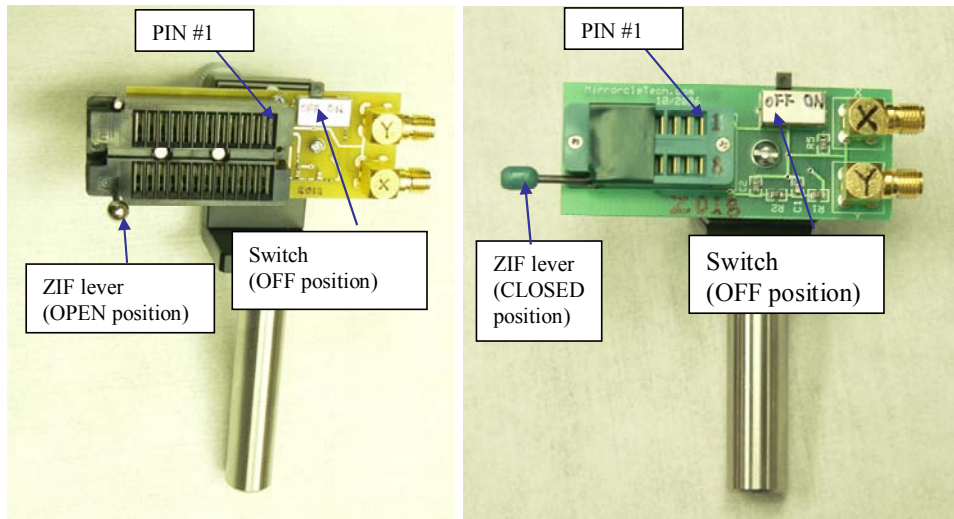
Recommended optical setup



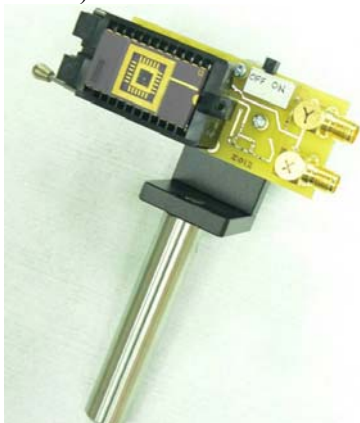
Recommended optical setup for development kits with the optional Wide-Angle Lens. Lens is optimized for a distance of 40cm to display.

STEP 5: Both for the 24-pin holder and the 8-pin holder, the ZIF lever indicates the bottom of the socket (opposite a “normal” ZIF configuration.) On the micromirror chip the notch indicates the top of the chip and the

gold square denotes pin #1. Take care not to touch the protective glass covering the micromirror device. See figures below for more details.



Prior to inserting the device into the ZIF socket slide the switch on the micromirror PCB to the OFF position, then raise the lever on the ZIF socket to the up position (90° to PCB.) Carefully insert the micromirror DIP into the ZIF socket and gently lower the ZIF lever to the down position (CAUTION: do not allow the lever to snap down!)



A micromirror chip properly inserted and locked into the ZIF on the micromirror PCB. Note that the switch remains in the OFF position.

CAUTION: The micromirror chips are sensitive to electrostatic discharge, insure that you are well grounded prior to removing the chip from its package and while inserting the chip into the socket. Also, when inserting the chip take extra care to insure the pins are aligned and not bent during the insertion processes.

CAUTION: Prior to connecting the HV amplifier to the micromirror PCB make sure that the switch on the micromirror PCB is in the OFF position.

STEP 6: (1-quadrant kit) Connect the SMA cables to the HV amplifier box. (4-quadrant kit) Connect the 10-pin ribbon cable to the HV amplifier box.

STEP 7: Ensure the HV amplifier is connected to the DAQ port on the PC. For USB-version, ensure the HV amplifier daughterboard is in place inside the USB-6221 enclosure.

STEP 8: Start the software “MirrorcleDraw” from the Mirrorcle folder of your computer’s Programs menu. In the software’s graphical user interface (GUI) ensure that the output device is selected to be the proper DAQ card and ensure that the voltage level is set to the minimum value.

STEP 9: (1-quadrant kit) Connect the other ends of the SMA cables from the HV amplifier to the micromirror miniPCB, matching the label for the X axis on the miniPCB and the respective label on the amplifier box. (4-quadrant kit) Connect the other end of the 10-pin ribbon cable to the micromirror miniPCB.

STEP 10: Select “Curve Plot” as the program mode, and select “sine wave.”

-It is suggested that you select “Bessel” with a cut-off 2000 Hz and 6 poles

-Click on “enable high voltage” on the GUI. The red LED on the amplifier box should be ON.

-Set the switch on the micromirror PCB to the ON position

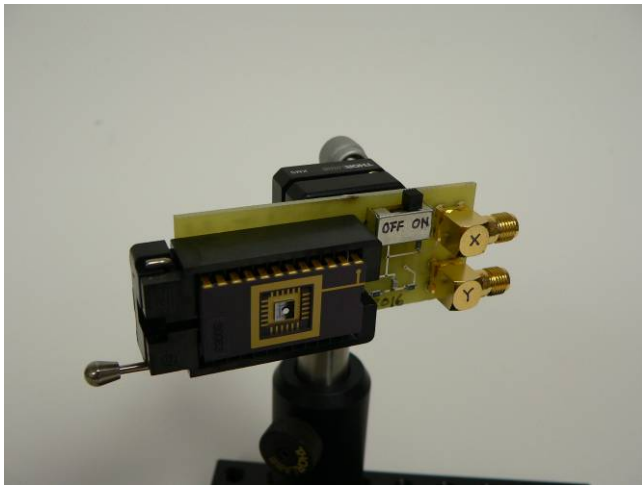
-Adjust the voltage level to 75V and align the optics. **Do not exceed voltages prescribed for each individual device. They are noted on page 2 of each specific device’s characterization report or datasheet.** Congratulations... you are ready to continue!

TURNING OFF THE DEVELOPMENT KIT:

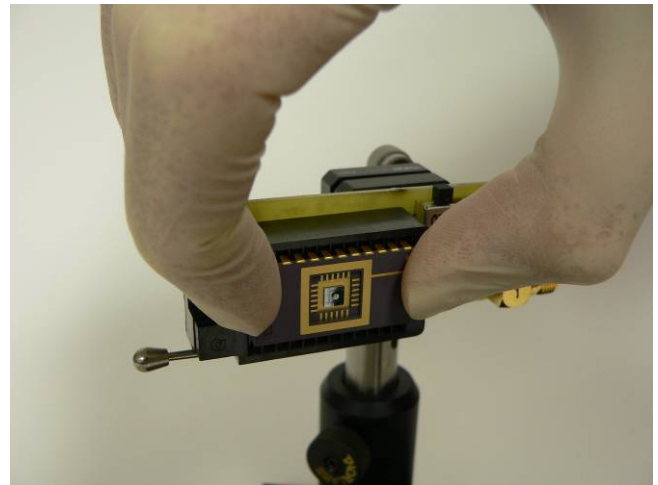
Unplugging the HV amplifier from power (DAQ card cable or USB cable or external AC adapter, whichever is used) could damage the micromirror device. This should never be done with micromirror in the socket and miniPCB should always be off. In order to avoid damage and possible software problems, always properly turn off as shown below, and then remove the USB connection.

- Adjust the voltage level to the minimum value *in sequential steps*
- Disable the high voltage amplifier by de-selecting “HV Amp Enable” in the GUI
- Set the switch on the micromirror PCB to the OFF position
- Close the development software (before unplugging USB)
- Disconnect the HV amplifier from USB as a very last step
- Disconnect the HV amplifier from the DAQ card if necessary

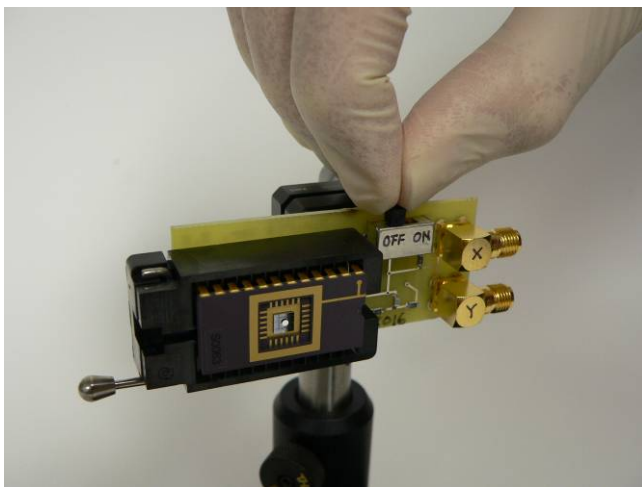
Appendix 1: Replacing the Micromirror Device Chip



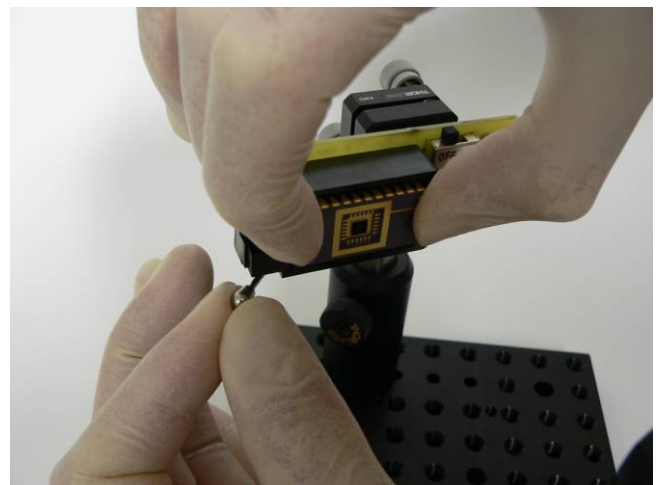
1. In software, reduce voltage setting to minimum and turn OFF Enable Amp. Confirm that the X and Y voltages are close to zero. Person should be wearing clean lab gloves when handling devices.



3. Using two fingers hold the edges of the package.

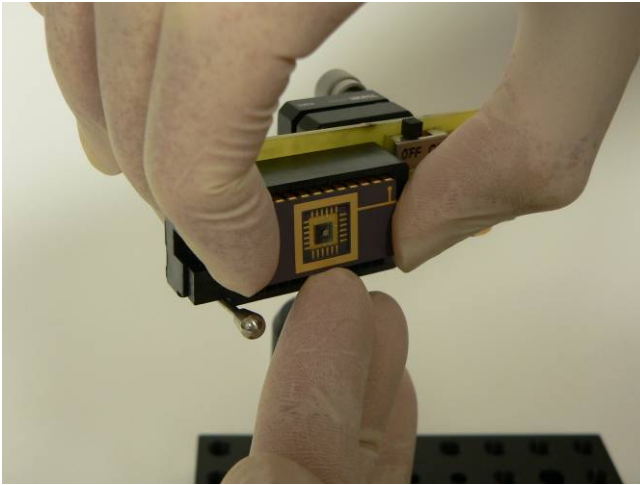


2. Turn off the *MiniPCB* switch.

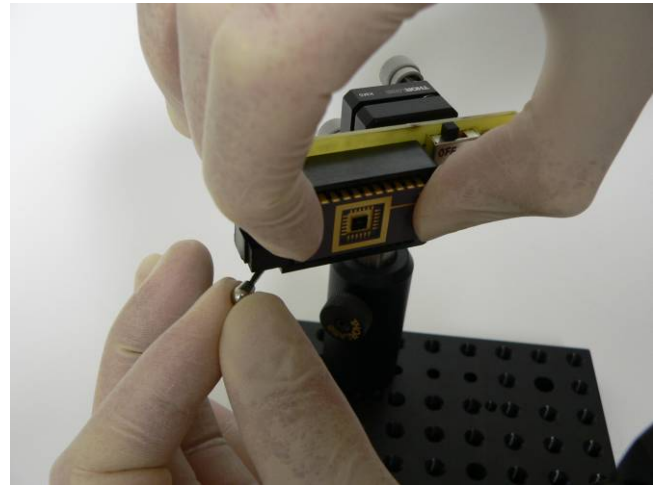


4. While holding the package against the *MiniPCB*, to prevent it from falling out when the ZIF lever is released, slowly release the package by moving the lever on the ZIF package to the open position using two fingers.

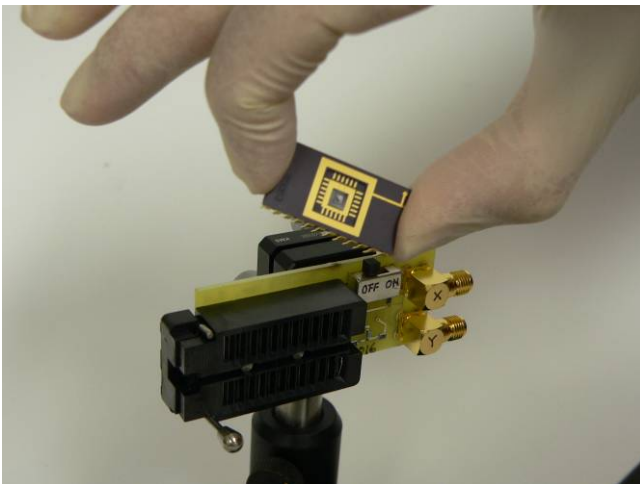
Appendix 1: Replacing the Micromirror Device Chip – cont.



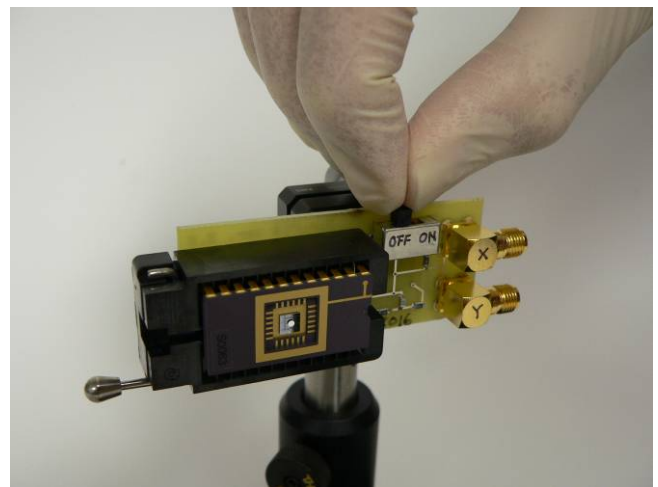
5. Carefully remove the package from the ZIF, taking care to hold it only on the package sides, and not in any areas near the device cavity and the device itself. It can be helpful to ease the package out of the ZIF using one finger from below, as shown in the image above.



7. Insert the package into the ZIF socket and hold it flush against the ZIF by using two fingers. Capture the package in the ZIF by closing the lever slowly. Do not allow the ZIF lever to snap using spring force – the shock may damage the device – always use fingers to control its position.



6. Remove package. Replace the package by the reverse process, again taking care not to touch the micromirror die within the package cavity, or wirebond area by holding the package only at the edges as shown.



8. You may need to make adjustments in the position of the *MiniPCB*, lens, or laser. Connect the SMA cables and turn on the *MiniPCB*. The micromirror device is now ready to be used

Appendix 2: Versions of the amplifiers

1) Standard DAQ-compatible High Voltage Amplifier



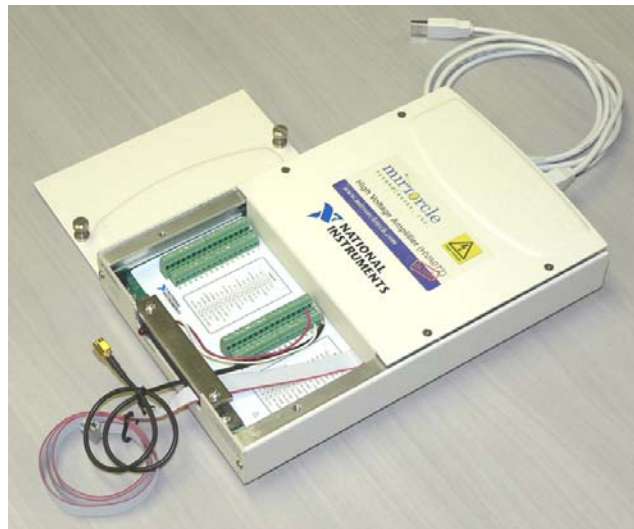
Input is a 68-pin connector for National Instruments DAQ cards (see appendix 4.) Amplifier does not require external power supplies since +5VDC is provided from the DAQ card on the connector. Outputs are X and Y high voltage analog channels and digital output M. Green LED denotes that the 5VDC supply is available i.e. that a working NI DAQ card is plugged in properly and the red LED denotes that the high voltage supply (170V) section of the amplifier is enabled (via software.)

2) DAQ-compatible High Voltage Amplifier with Stand-Alone option (ver. 2.2 or higher and S/N HVA033 or higher)



Input is a 68-pin connector for National Instruments DAQ cards (see appendix 4.) Amplifier does not require external power supplies since +5VDC is provided from the DAQ card on the connector. If DAQ connector is not present, power can be provided with a +5VDC supply. Additional input is the female stereo jack connector on the back panel for external inputs. When a 3.5mm stereo jack (shown in the figure with 2 BNC connector adapters,) is present and plugged in, the inputs will automatically be diverted from NI DAQ connector to the two external BNC inputs. In order to use NI DAQ inputs, the stereo jack must be removed. Outputs are X and Y high voltage analog channels and digital output M. Green LED denotes that the 5VDC supply is available i.e. that a working NI DAQ card is plugged in properly and the red LED denotes that the high voltage supply (170V) section of the amplifier is enabled (via software or via the front panel override enable switch.) In stand-alone applications without NI-DAQ, external +5VDC adapter should be plugged in, the stereo jack to 2x BNC connector should be plugged in, and the override enable switch on the front panel should be ON.

3) USB DAQ-compatible High Voltage Amplifier



Amplifier is embedded with the National Instruments USB DAQ card. Amplifier does not require external power supplies since +5VDC is provided from the DAQ card internally. Full functionality of the USB DAQ is available and accessible through the terminals. In addition, high voltage analog outputs are provided by the MirrorcleTech amplifier via the 10-pin ribbon cable. An SMA connector is provided for digital output P0.0 which is utilized in MirrorcleTech software as a laser modulation (blinking) output.

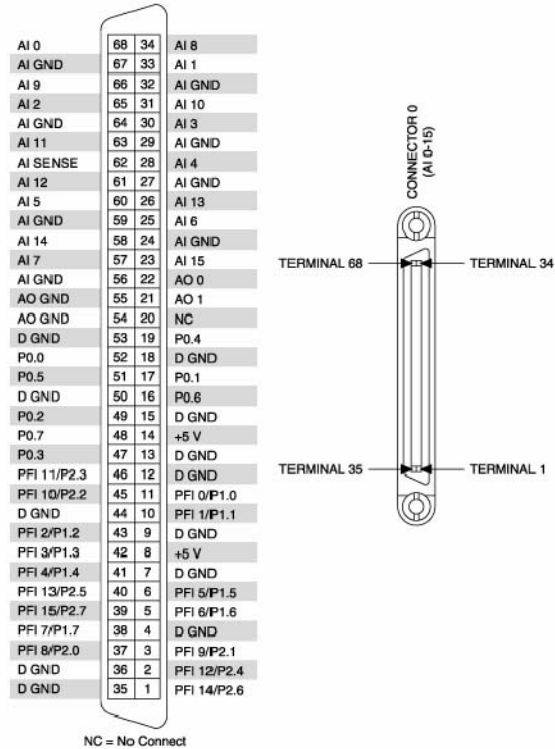
Appendix 3: Operating the PCI-version HV Amplifier in the Stand-Alone Mode

FEATURES:

- Use as stand alone 2 channel high-voltage amplifier
- Voltage Gain of 15X, single-sided supply with 0 to 150V output
- Requires external +5VDC power supply, with center-positive plug (5.5mm OD, 2.5mm ID). Alternatively can be powered by the DAQ card (68-pin connector,) although the DAQ might not be used as the analog voltage source. Both the DAQ 68-pin connector and the external supply should not be used simultaneously, although on-board circuits should ensure proper switching between them.
- Amplifier will auto-detect external inputs when 3.5mm stereo jack is plugged in at the back of the amplifier. Once this connection is made DAQ analog output voltages are ignored and the amplifier is in “stand-alone mode.”
- If DAQ card is plugged in, software can still control the high-voltage enable switch on board. However, in fully stand-alone applications, with no DAQ card present, enable can be over-ridden by the switch provided on the front panel of the amplifier “Enable Override”

Appendix 4: National Instruments 6221 DAQ Card Connector Diagram

NI 6221



Appendix 5: HV Amplifier to 68-Pin DAQ Connections

DAQ Connector Pin No.	DAQ Pin Name	Usage	Connection on Amplifier PCB
8	+5 V	5V DC Supply for Amplifier Power	All circuits
4, 7, 9, 12, 13	D GND	Digital Ground	PCB Ground
11	P 1.0	Amplifier Enable (digital)	Controls oscillator for DC-DC converter
21	AO 1	Y Axis Voltage (analog)	Input to amplifier
22	AO 0	X Axis Voltage (analog)	Input to amplifier
52	P 0.0	Laser Modulation On/Off (digital)	Connected directly to external SMA conn.
68	AI 0	Analog Input 0 (unused)	Pin on PCB (unused)
33	AI 1	Analog Input 1 (unused)	Pin on PCB (unused)
65	AI 2	Analog Input 2 (unused)	Pin on PCB (unused)
30	AI 3	Analog Input 3 (unused)	Pin on PCB (unused)
62	AI SENSE	Analog Input Sense (unused)	Pin on PCB (unused)
29, 32, 64, 67	AI GND	Analog Input Ground	PCB Ground
54, 55	AO GND	Analog Output Ground	PCB Ground

Appendix 6: Mirrorcle PCI-Based Development Kit Amplifier - DAQ Compatibility*

Compatible with following National Instruments DAQ cards:

M-series:

NI PCI-6221, NI PCI-6225, NI PCI-6229, NI PCI-6251, NI PCI-6255, NI PCI-6259, NI PCI-6281, NI PCI-6289
NI USB-6225 Mass Termination, NI USB-6251 Mass Termination, NI USB-6255 Mass Termination,
NI USB-6259 Mass Termination, NI USB-6281 Mass Termination, NI USB-6289 Mass Termination

B-series and E-series:

NI 6014
NI 6015 Mass Termination
NI PCI-6024E, NI DAQCard-6024E (for PCMCIA)
NI 6030E, NI 6036E, NI DAQCard-6036E (for PCMCIA)
NI 6040E, NI 6052E
NI PCI-6062E, NI DAQCard-6062E (for PCMCIA)
NI 6070E

S-series:

NI 6110, NI 6111, NI 6115, NI 6120

Analog Output:

NI 6711, NI 6713, NI 6715, NI 6722, NI 6723, NI 6731, NI 6733

And perhaps others that use the same 68-pin connector pinout for critical connections (see Appendix 5)

Note that the modulation (M) channel will work with a subset of those cards, while X and Y channels will work in all the cases.

For example, M-series cards such as **NI PCI-6221**, **NI PCI-6229**, **NI PCI-6251**, **NI PCI-6259** readily provide correlated DIO which enables the streaming of the laser-modulation or M-channel. This channel may also be utilized to convey timing information to other components of an experimental setup because it is synchronized to the analog outputs X and Y axis drive signals, and therefore to the position of the MEMS micromirror.

Recommended NI DAQ Card:

We recommend the **NI PCI-6221** M-series card. It is the lowest cost card and enables full capabilities of the kit. The card should include a 68-pin shielded cable which is compatible with our amplifiers. We recommend the 2m long cable: SHC68-68-EP Shielded Cable, 68 D-Type to 68 VHDCI Offset, 2 m

**Note that USB-compatible development kit includes the NI USB 6221 DAQ card. The above compatibility chart applies only to PCI-compatible development kit hardware.*