WHITE PAPER

All-in-One (AIO) Integration with Thin Mini-ITX Intel® Desktop Boards

Revision History

Revision	Revision History	Date
1.0	Initial release of the All-in-One (AIO) Integration with Intel Desktop Boards White Paper	November 2012
2.0	Added AIO chassis models	December 2012
3/0	Updated URLs	September 2013

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1. Introduction

LVDS flat panel displays are the building block for all modern flat panel monitors. The interface for such displays, however, is not standardized and, as a consequence, LVDS enabling on Intel Desktop Boards follow a specific implementation. 14.97

EMC certification is highly dependent on the system chassis. While Intel Desktop Boards with LVDS support are tested for EMI compliance with LVDS enabled, the actual EMC certification of the board is performed using standard "off-the-shelf" desktop-style chassis (not an LVDS panel).

System builders who enable LVDS on their product lineup own the support and EMC certification of such systems for end-users.

Table 1 summarizes the major features of the LVDS flat panel display interface implementation on Intel Desktop Boards.

Table 1: LVDS Interfaces on Intel Desktop Boards

Panel Connectivity	40-pin header (data, clock, EDID and panel logic power)
Panel Power	Voltage selection jumper for 3.3V, 5V, or 12V panel voltage support
Inverter Connectivity	8-pin header supporting backlight lamp PWM control and inverter power
Inverter Power	Voltage selection jumper for 5V or 12V backlight inverter voltage support

The AIO specification requires all cables to be built into the chassis, including cables and connectors for LVDS, SATA drives, power, etc.

Useful sites:

- Thin Mini-ITX-based All-in-One Computers
- Customization and Integration

2. Supported thin mini-ITX Intel Desktop Boards

The following Intel Desktop Boards in the **thin mini-ITX** form factor support LVDS and All-in-One chassis integration.

- Intel® Desktop Board DH61AGL
- Intel® Desktop Board DQ77KB
- Intel® Desktop Board DH61AG
- Intel® Desktop Board DN2800MT

See **Appendix A** for **mini-ITX** boards that include LVDS support.

3.1 Locations of connectors and headers

3.1.a Intel® Desktop Board DH61AGL

Figure 1 shows the locations of the LVDS connectors and headers on the Intel Desktop Board DH61AGL.

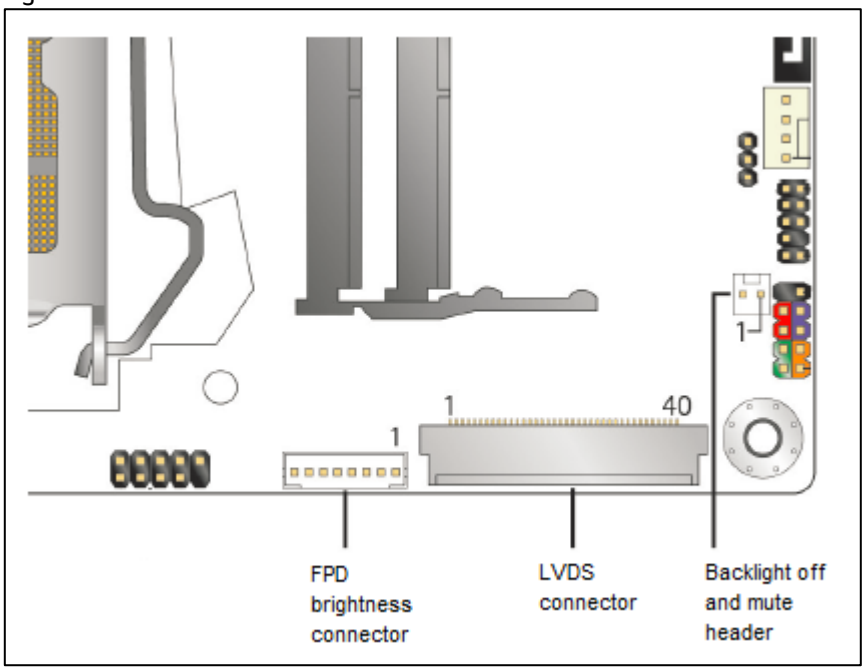


Figure 1: LVDS connectors and headers for Intel Desktop Board DH61AGL.

3.1.b Intel® Desktop Board DQ77KB

Figure 2 shows the locations of the LVDS connectors and headers on the Intel Desktop Board DQ77KB.

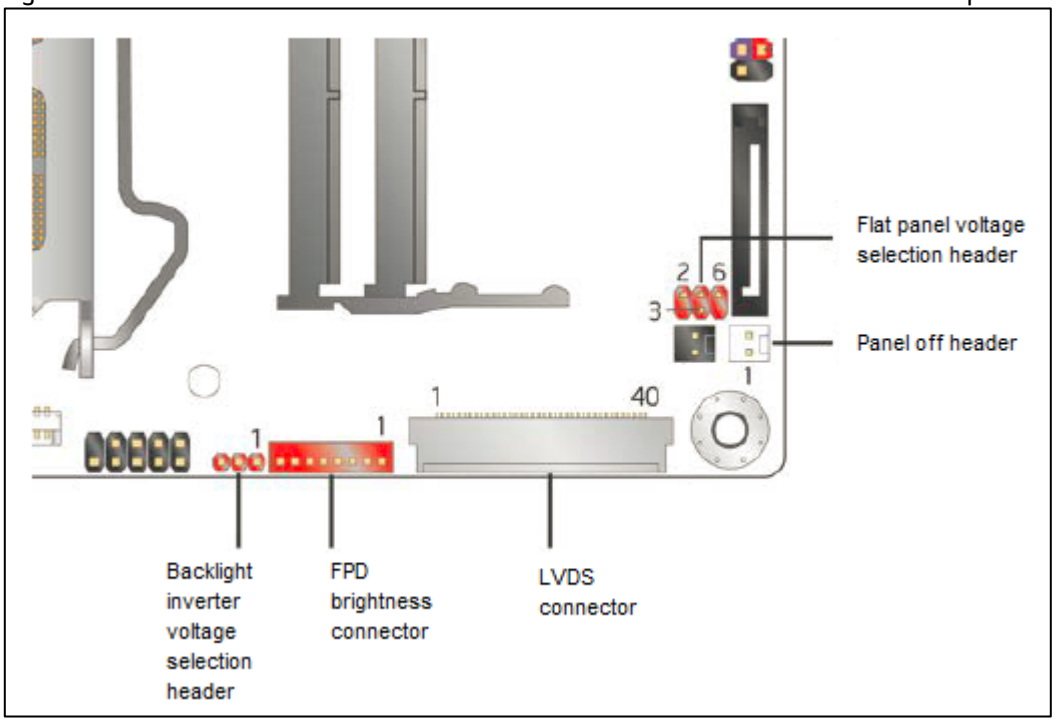


Figure 2: LVDS connectors and headers for Intel Desktop Board DQ77KB.

3.1.c Intel® Desktop Board DH61AG

Figure 3 shows the locations of the LVDS connectors and headers on the Intel Desktop Board DH61AG.

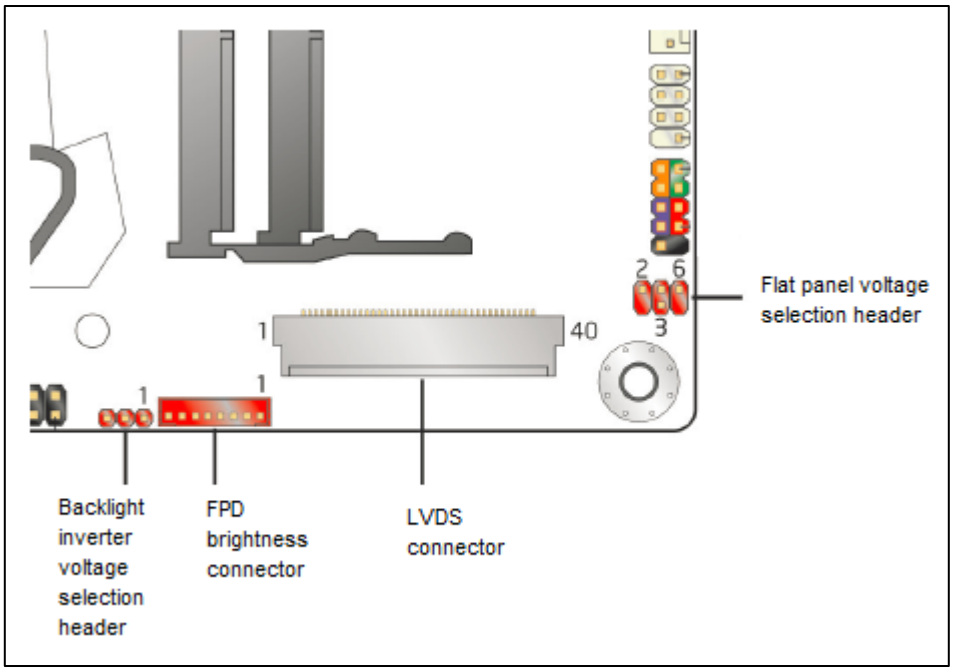


Figure 3: LVDS connectors and headers for Intel Desktop Board DH61AG.

3.1.d Intel® Desktop Board DN2800MT

Figure 4 shows the locations of the LVDS connectors and headers on the Intel Desktop Board DN2800MT.

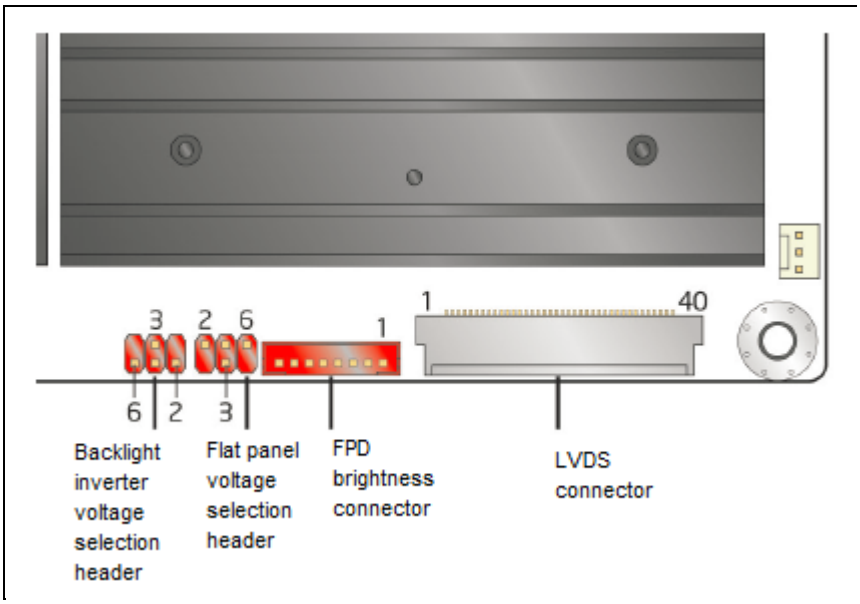


Figure 4: LVDS connectors and headers for Intel Desktop Board DN2800MT.

3. Connectors

3.1 LVDS connector

The LVDS panel connector is a 40-pin (dual-row) shrouded white header, supporting video data, clock, and EDID signals, as well as panel logic power. This connector/cable ships already built into the AIO chassis and does not need to be purchased separately.

Table 2: 40-pin LVDS connector signals

Pin	Signal name	Pin	Signal name
1	ODD_Lane3_P	21	N/C
2	ODD_Lane3_N	22	EDID_3.3 V
3	ODD_Lane2_P	23	LCD_GND
4	ODD_Lane2_N	24	LCD_GND
5	ODD_Lane1_P	25	LCD_GND
6	ODD_Lane1_N	26	ODD_CLK_P
7	ODD_Lane0_P	27	ODD_CLK_N
8	ODD_Lane0_N	28	BKLT_GND
9	EVEN_Lane3_P	29	BKLT_GND
10	EVEN_Lane3_N	30	BKLT_GND
11	EVEN_Lane2_P	31	EDID_CLK
12	EVEN_Lane2_N	32	BKLT_ENABLE
13	EVEN_Lane1_P	33	BKLT_PWM_DIM
14	EVEN_Lane1_N	34	EVEN_CLK_P
15	EVEN_Lane0_P	35	EVEN_CLK_N
16	EVEN_Lane0_N	36	BKLT_PWR (12 V/19 V)
17	EDID_GND	37	BKLT_PWR (12 V/19 V)
18	LCD_VCC (3.3 V/5 V/12 V)	38	BKLT_PWR (12 V/19 V)
19	LCD_VCC (3.3 V/5 V/12 V)	39	N/C
20	LCD_VCC (3.3 V/5 V/12 V)	40	EDID_DATA

Note: LVDS single-channel output is driven from the ODD signals.

3.2 Front panel display (FPD) brightness connector

The backlight inverter power connector is an 8-pin (single-row) shrouded header, supporting backlight lamp enable and PWM control signals as well as inverter power. This connector/cable ships already built into the AIO chassis and does not need to be purchased separately.

Table 3: FPD brightness connector signals

Pin	Signal name	Description
1	BKLT_EN	Backlight enable
2	BKLT_PWM	Backlight control
3	BKLT_PWR (12 V/19 V)	Backlight inverter power
4	BKLT_PWR (12 V/19 V)	Backlight inverter power
5	BKLT_GND/Brightness_GND	Ground (shared)
6	BKLT_GND/Brightness_GND	Ground (shared)
7	Brightness_Up	Panel brightness increase
8	Brightness_Down	Panel brightness decrease

4. Onboard headers

4.1 Panel voltage selection header

Intel Desktop Boards with LVDS interface connectivity provide configurable voltage levels for powering a wide range of display panels. The AIO specification requires the panel voltage to be 5V.

Table 4 shows the signals for the panel voltage selection header.

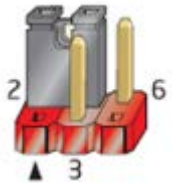
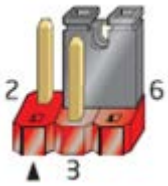
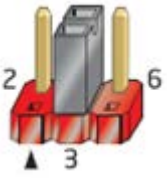
Table 4: Panel voltage selection header signals

Pin	Signal name	Description	Pin	Signal name	Description
1	Key	No pin	2	3.3 V	3.3 V option
3	12 V	12 V option	4	LCD_VCC	Send voltage to connector
5	Key	No pin	6	5 V	5 V option

Intel Desktop Board DH61AGL does not have a panel voltage selection header; the panel voltage for DH61AGL is hard-coded to 5V and is not changeable.

Table 5 shows the panel voltage options that can be selected for **Intel Desktop Boards DQ77KB, DH61AG**, and **DN2800MT**.

Table 5: Panel voltage selection header options

Voltage	Pin configuration	Notes
3.3V option		This is the default setting for **Intel Desktop Boards DQ77KB** and **DH61AG**.
5V option		This is the default setting for **Intel Desktop Board DN2800MT** (board revision -801 and later).
12V option		

4.2 Backlight inverter voltage selection header

The board provides configurable voltage levels for powering diverse backlight inverter boards. The AIO specification requires the inverter voltage to be 19V.

Intel Desktop Board DH61AGL does not have a backlight inverter voltage selection header; the inverter voltage for DH61AGL is hard-coded to 19V and is not changeable.

For **Intel Desktop Boards DQ77KB** and **DH61AG**, the backlight inverter power header supplies a voltage level of 5V or 12V by setting the 1x3 selection header with a jumper.

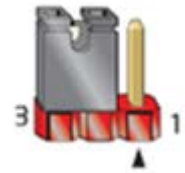
Table 6 shows the signals for the backlight inverter voltage selection 1x3 header.

Table 6: Backlight inverter voltage selection header signals (1x3)

Pin	Signal name	Description
1	12 V	12 V option
2	BKLT_PWR	Send voltage to connector
3	19 V	19 V option

Table 7 shows inverter voltage options that can be selected for **Intel Desktop Boards DQ77KB** and **DH61AG**.

Table 7: Backlight inverter voltage selection header options for Intel Desktop Boards DQ77KB and DH61AG

Voltage	Pin configuration	Notes
12V option		This is the default setting for **Intel Desktop Boards DQ77KB** and **DH61AG**.
19V option		

For **Intel Desktop Board DN2800MT**, the backlight inverter power header supplies a voltage level of 5V, 12V, or Vin by setting the 2x3 selection header with a jumper.

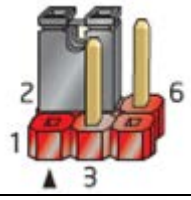
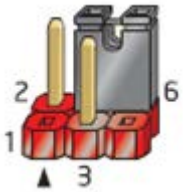
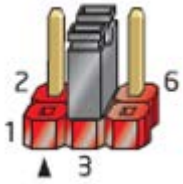
Table 8 shows the signals for the backlight inverter voltage selection 2x3 header.

Table 8: Backlight inverter voltage selection header signals (2x3)

Pin	Signal name	Description	Pin	Signal name	Description
1	Key	No pin	2	5 V	5 V option
3	Vin	Board input voltage option	4	BKLT_PWR	Send voltage to connector
5	Key	No pin	6	12 V	12 V option

Table 9 shows inverter voltage options that can be selected for **Intel Desktop Board DN2800MT**.

Table 9: Backlight inverter voltage selection header options for Intel Desktop Board DN2800MT

Voltage	Pin configuration	Notes
5V option		
12V option		
Vin option *(wide range system voltage input)*		This is the default setting for **Intel Desktop Board DN2800MT**.

4.3 Backlight-off and mute header

Intel Desktop Board DH61AGL includes a backlight-off and mute header. This header can be connected to chassis that support a button that turns off the backlight unit and mutes onboard audio.

Table 10 shows the signals for the backlight-off and mute 1x2 header.

Table 10: Backlight-off and mute header signals

Pin	Signal name	Description
1	BKLT_OFF	Backlight off & mute signal
2	Ground	Ground

4.4 Panel_off header

Intel Desktop Board DQ77KB includes a panel-off header. This header can be connected to chassis that support a button that turns off the monitor.

Table 11 shows the signals for the Panel_off 1x2 header.

Table 11: Panel_off header signals

Pin	Signal name	Description
1	Ground	Ground
2	Monitor_off	Monitor off

5. Tested All-in-One chassis

Table 12: Test result for All-in-One (AIO) chassis

Board → / ↓ Chassis	DH61AG	DH61AGL	DQ77KB	DN2800MT
DQ* E24GII 24"	●	●	●	
ECS* G11 21.5"	●[4,2]	●[5,3]	●[5,3]	●[5,3]
ECS G24 24"	●[2]	●[2]	●[2]	●[2]
Gigabyte* AEBN 18.5"	●	●	●	○[6]
Jumper* ET30	●[11]	●[11]	●[11]	●[11]
KME* A206D 21.5"	●[3,9]	●[3,9]	●[3,9]	●[3,9]
LGE* 22AM3 3NB 21.5"	●[3]	●[3]	●[3]	●[3]
Loop* 2150 21.5"	●[1,10]	●[1,10]	●[1,10]	●[1,10]
Loop 2151 21.5"	●[1,10]	●[1,10]	●[1,10]	●[1,10]
Mitac* 650 21.5"	●[9,2]	●[9,2]	●[8,9,2]	●[9,2]
Mitac 770 21.5"	●	●	●	
Wibtek* A21 21.5"	●[7,10]	●[7,10]	●[7,10]	●[7,10]
Wibtek A23 21.5"	●	●	●	●

See the latest AIO compatibility matrix at http://www.intel.com/content/www/us/en/hardware-developers/channel-aio-compatibility-matrix.html.

Legend:

● - Fully compatible: all essential system features work; defined as display, speakers, webcam, microphone, touch (if present), side USB ports.

○ - Not compatible: chassis and motherboard combination cannot be integrated, or require modification.

Annotations:

[1] AIO chassis only supports a single Wi-fi antenna.

[2] AIO chassis does not support the Intel standard thermal solution for AIOs (HTS1155LP).

[3] Thermal Solution not included. Compatible with Intel standard thermal solution for AIOs (HTS1155LP).

[4] ECS: There is an extra cable for 1x2 "monitor off" feature in ECS G11 which is not defined in the AIO Design Guide, so the Intel boards don't support this feature.

[5] Gigabyte: There is an extra cable for "Wi-Fi LED" feature introduced by Gigabyte, not defined in the AIO Design Guide. There are no plans to add the "WiFi LED" feature to Intel boards.

[6] Gigabyte: Intel Desktop Board DN2800MT board rev -600 is not compatible with the single-channel LVDS cable provided with the Gigabyte AEBN (18.5") chassis. Use board rev -800 or later. Refer to published Technical Advisory for details: Intel® Desktop Board DN2800MT - Technical Advisory – Single-Channel LVDS

[7] Wibtek A21:
a. The A21 I/O shield opening is not compliant with Thin Mini-ITX motherboard specification. Wibtek has acknowledged the issue. They are considering including a for Intel Desktop Board DN2800MT back panel ports which can be used in place of the Intel Desktop Board DN2800MT I/O shield.
b. Backlight driver board cable: Chassis cable connecting backlight driver board to motherboard is just long enough, requiring it to run over where the stand hinge needs to attach.

[8] Mitac: The Maestro 650 uses a custom heat pipe thermal solution. The CPU fan header connector on the Intel Desktop Board DQ77KB is underneath the heat pipe. The Mitac thermal solution is in violation of the Intel HTS1155LP KOZ, causing CPU blower cables to touch heat pipe.

[9] AIO chassis does not support a system fan. ODM uses alternative ways (e.g. thermal pad) to cool the VRs.

[10] AIO chassis supports a 3-wire system fan. The Version 1.0 of the AIO Design Guide recommends AIO Chassis to use a 4-wire system fan.

[11] Chassis requires full profile (Mini ITX) I/O shield

6. Integration steps (case study with Intel Desktop Board DH61AG)

This section is a case study of the integration of an Intel Desktop Board DH61AG in a Mitac Maestro 650 AIO chassis. The Mitac chassis comes with the AIO enclosure with the panel integrated, the power adapter, and the hard drive and optical drive cages pre-installed in the chassis.

6.1 Opening the chassis

Open the chassis by unscrewing the single screw on the top middle of the back cover.

Push the cover to the top

There are metal tabs that hold the back cover to the inside chassis pan. To remove the back cover, push the cover towards the TOP.

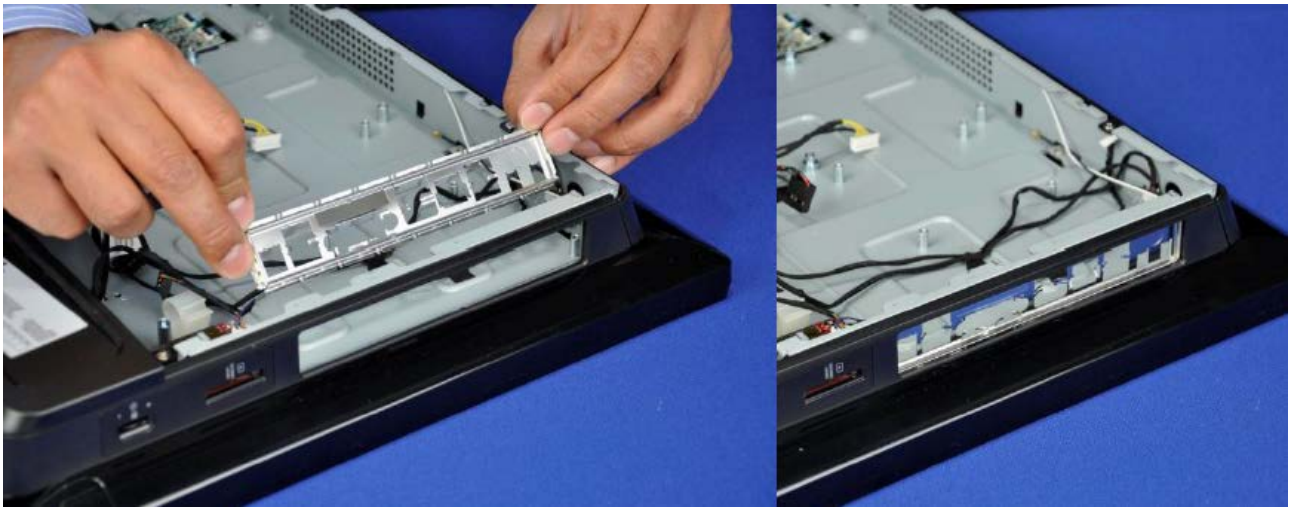
Lift the back cover

Once the cover has been pushed up about ½ cm, it can be lifted straight up. If the thermal solution is installed in the chassis, then remove it from the chassis.

6.2 Installing the desktop board

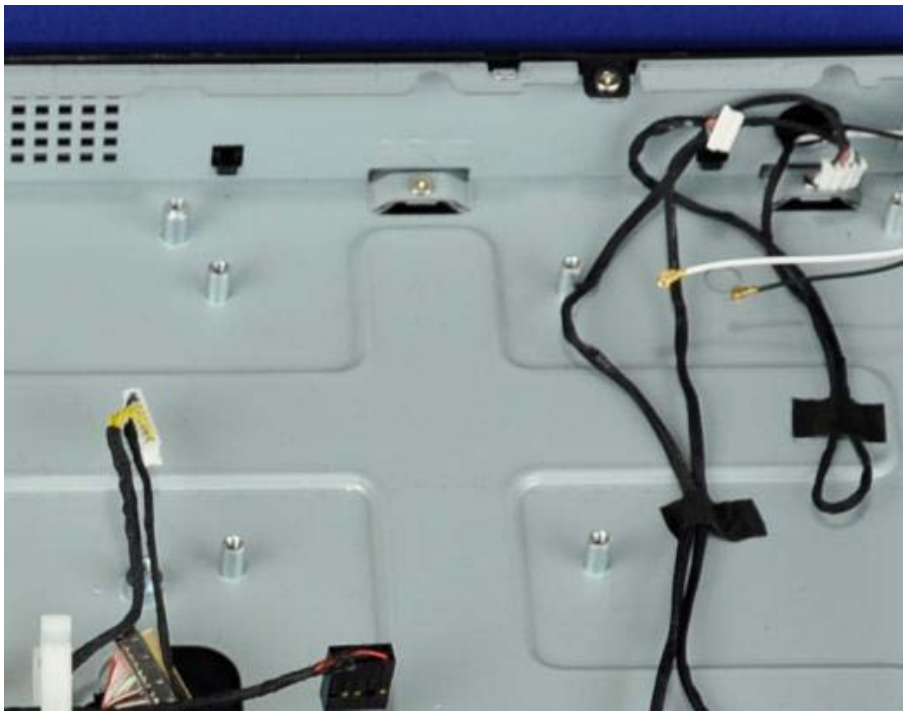
Install the I/O shield

Install the half-height IO shield that shipped with the DH61AG board. Push both ends in with your thumbs.



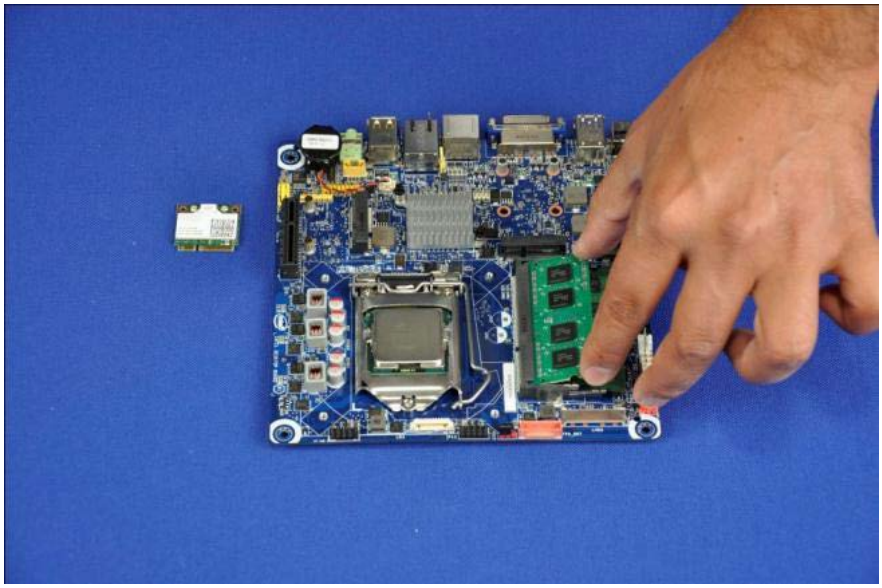
Thermal solution attaches to the board

The Mitac 650 chassis does not include a back plate; instead the thermal solution is attached to the board and the chassis through four screw standoffs, which are screwed into the chassis pan.



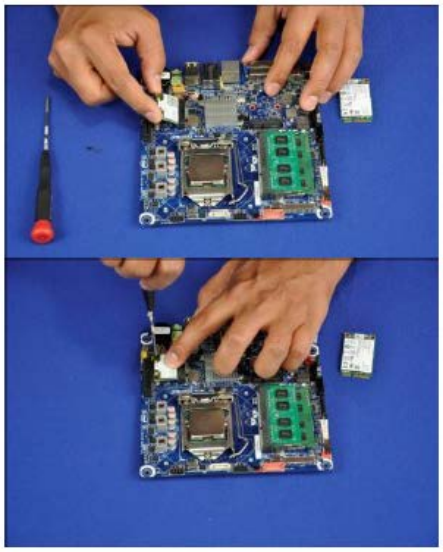
Install processor and memory

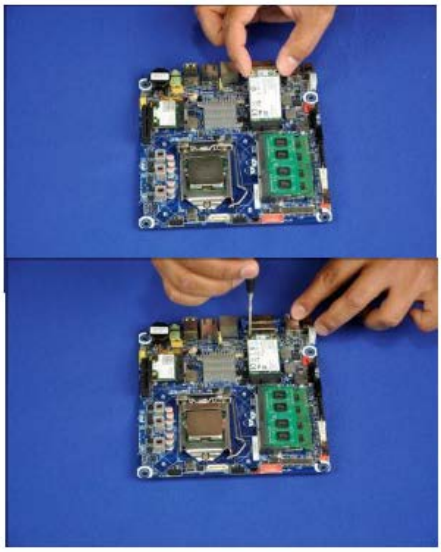
It is easier to install the smaller components (processor, SO-DIMM memory, mSATA SSD drive, wireless card) onto the board BEFORE installing the board in the AIO chassis.



Install mini-PCI expansion cards

Install the Wi-Fi module and mSATA SSD drives into the half-length and full length mini-PCIe slots respectively, and secure them with the retention screws.

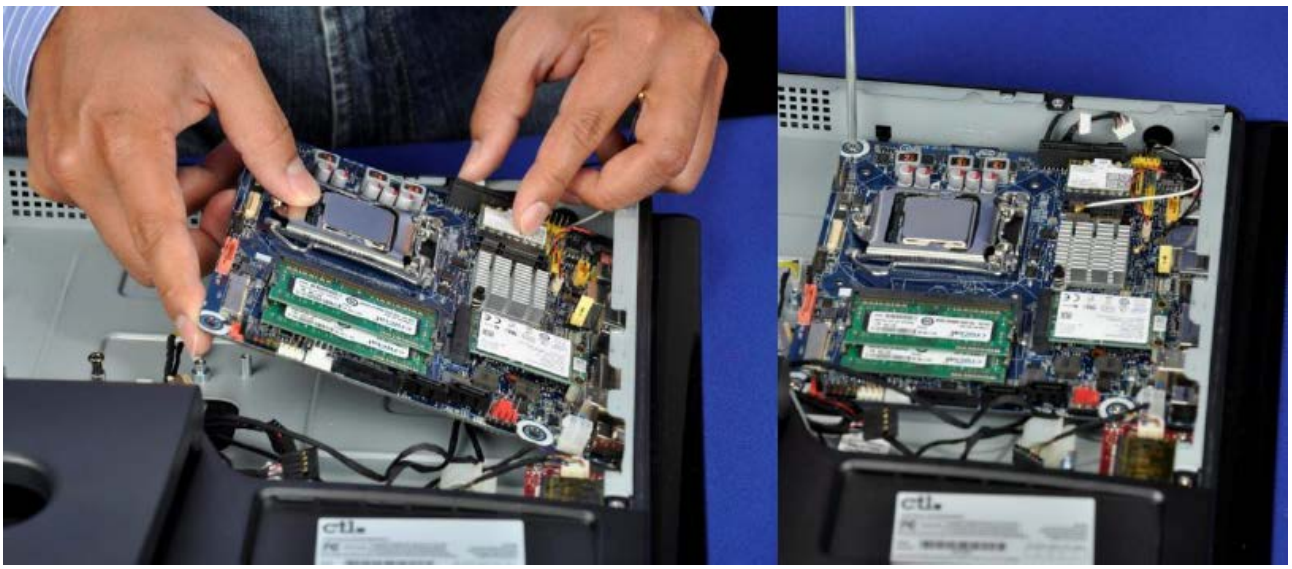




Integrate the board

Move all the wires away from the board area, and raise the metals tabs of the I/O shield before you install the board. Make sure no metal tabs are going inside the back panel ports.

Insert the motherboard at an angle, aligning all the back panel ports into the IO shield. Lay the board flat and screw in the four screws. The speaker wires go from the bottom of the chassis to the plug into the board connector which is at the top of the board, so these cables have to be placed at the bottom of the board.

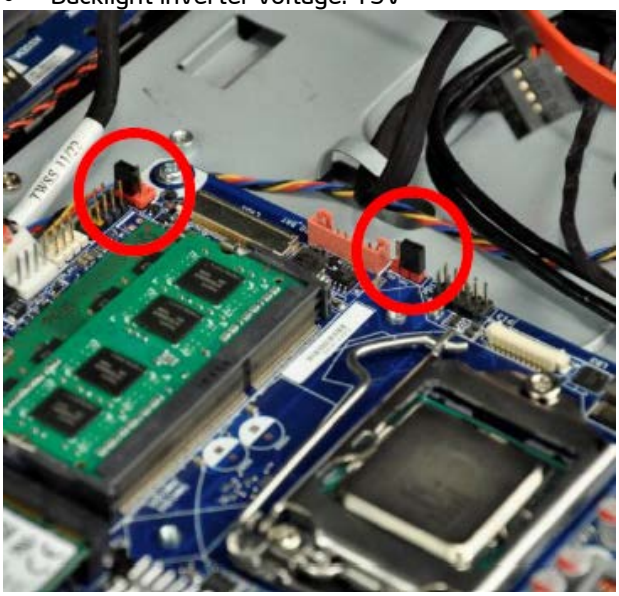


6.3 Connecting peripherals and cables

Display panel jumpers

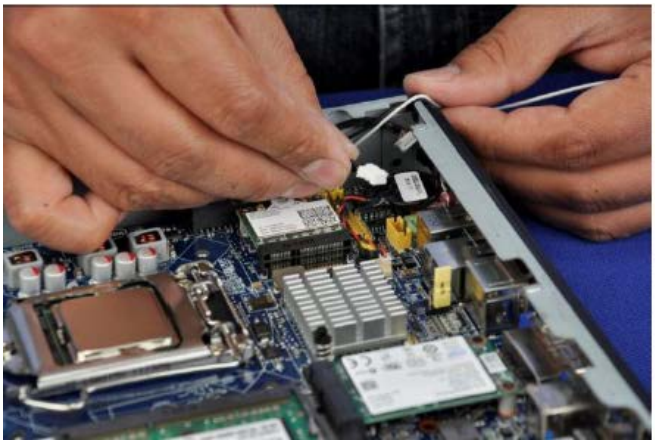
Before plugging in any cables, change the set the board jumpers to these settings:

- Flat panel voltage: 5V
- Backlight inverter voltage: 19V



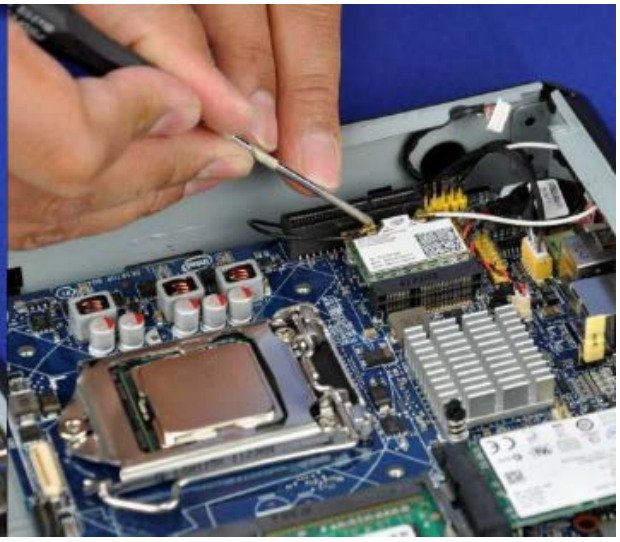
Internal speakers

The Mitac 650 AIO has 3 watt/4 ohm stereo speakers inside which get powered directly from the board. Connect the 4-pin white connector near the ½ length PCIe expansion slot to the internal stereo speaker connector which is 1x4-pin, shrouded.



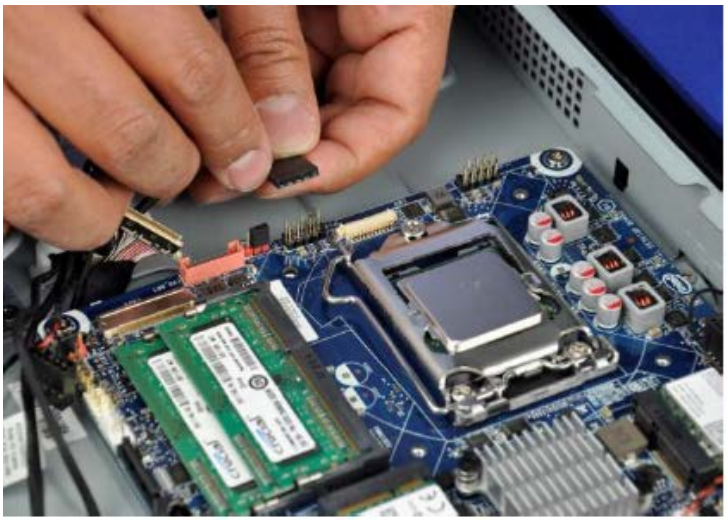
Wireless antenna

The Mitac AIO has two wireless (Wi-Fi) antennas pre-installed (white and black) with cables routed to the board area. Connect the cables' gold contacts to the wireless module. Use a fingernail or screwdriver head to push the plug into place, till you hear a click. Route the antenna cable over the board components as shown on the right, to prevent wire tangling.



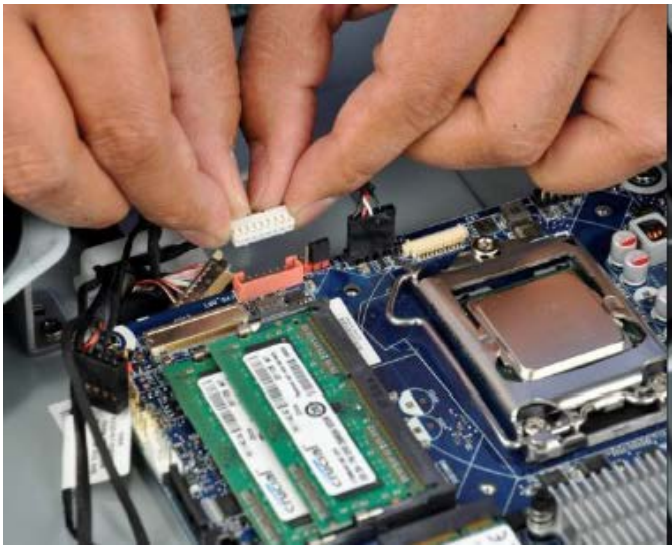
Touchscreen interface

If your Mitac 650 chassis supports an optical touchscreen interface, the touch interface is implemented as a single 1x5 USB header. Plug this cable into a single USB header (shown below next to the processor socket on the Intel Desktop Board DH61AG board).



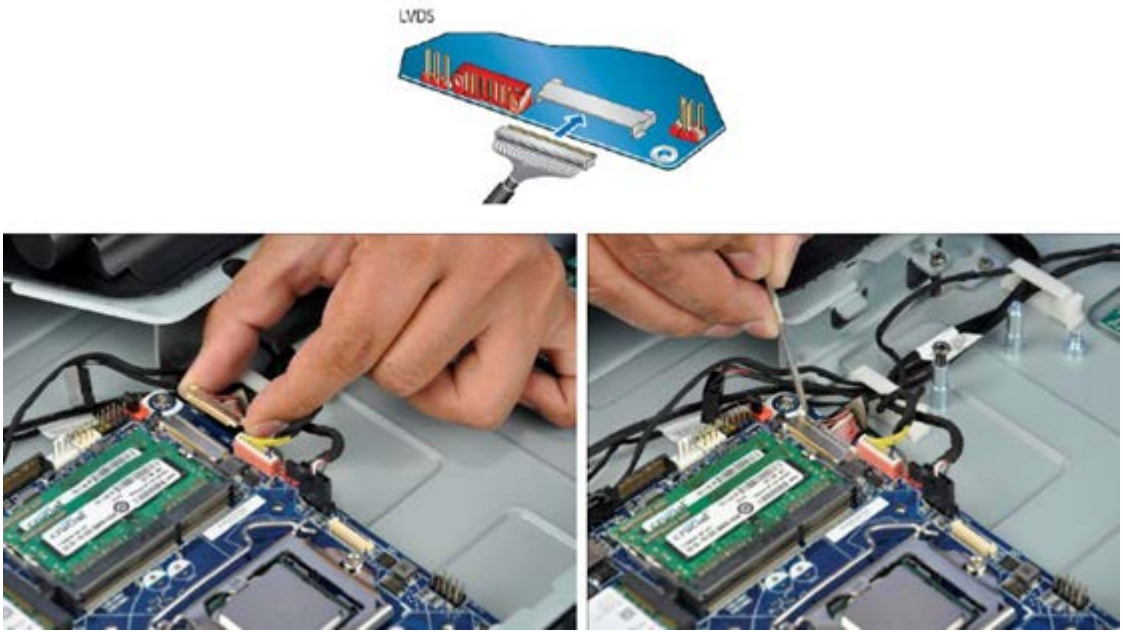
Flat panel backlight power and brightness

Insert the 8-pin shrouded panel power and brightness connector to the red connector next to the LVDS port. The connector is keyed so can only be plugged in one way. Make sure you have matched the 12V vs. 19V panel power jumper according to the panel specifications.



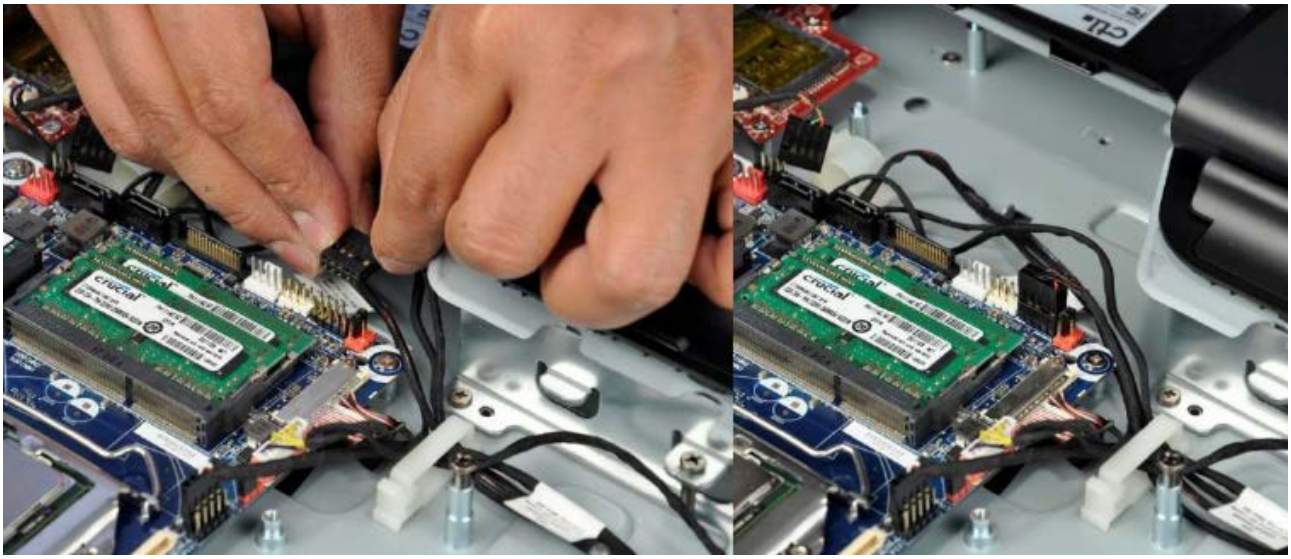
LVDS connector

Insert the flat silver ribbon cable with a 40-pin LVDS connector into the board's LVDS port on the top surface of the board. Note: there is another similar looking port on the bottom side which is an eDP* port (embedded DisplayPort*.) To ensure the connector is all the way in, use a screwdriver head to push in both sides of the connector.



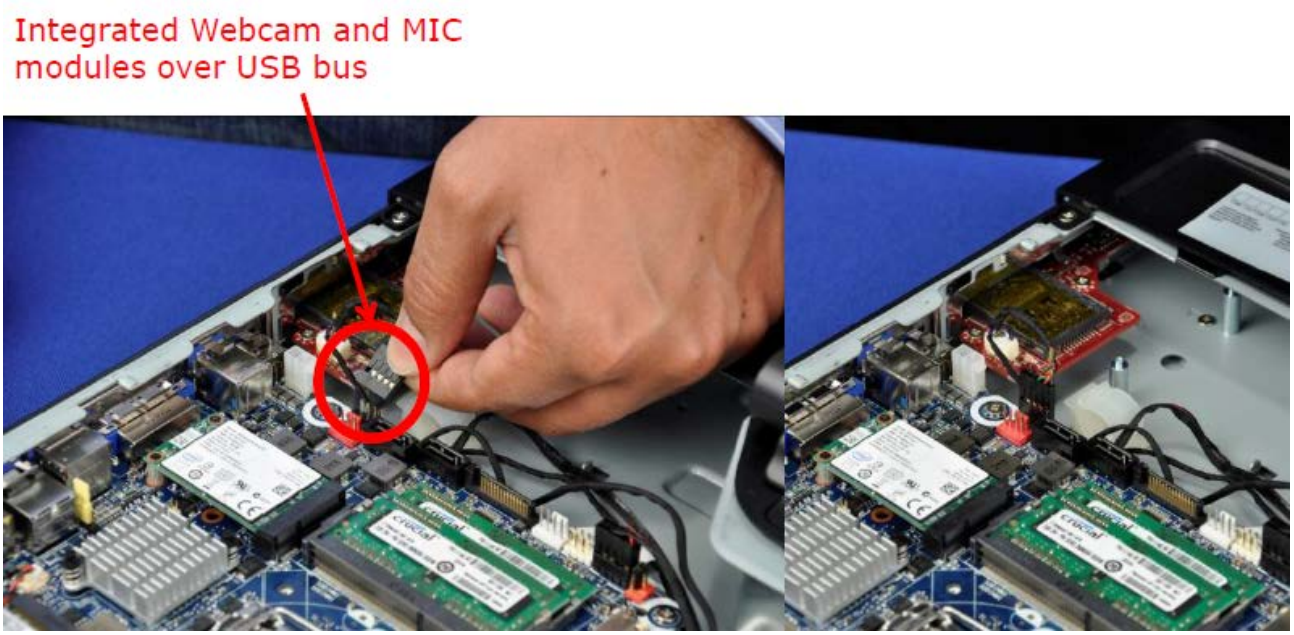
Front panel connector

Plug the front panel chassis cable to the board's front panel header. This connector includes the side power button, the HDD LED, and the reset button.



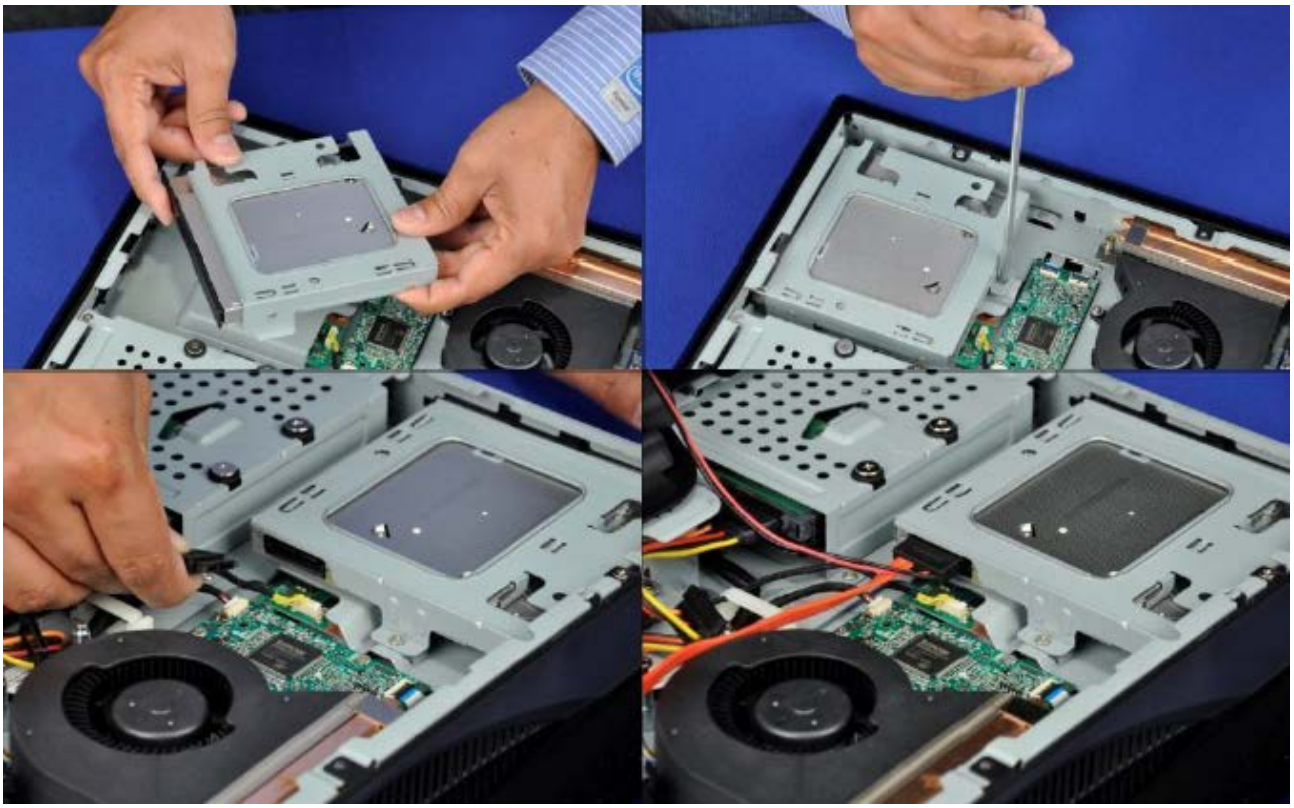
Webcam and digital MIC

In the Mitac 650 AIO chassis, the webcam and digital MIC are implemented as a single USB device with a 1x5 pin internal USB header connector. Plug it into a regular 4-pin USB port (next to SATA data ports).



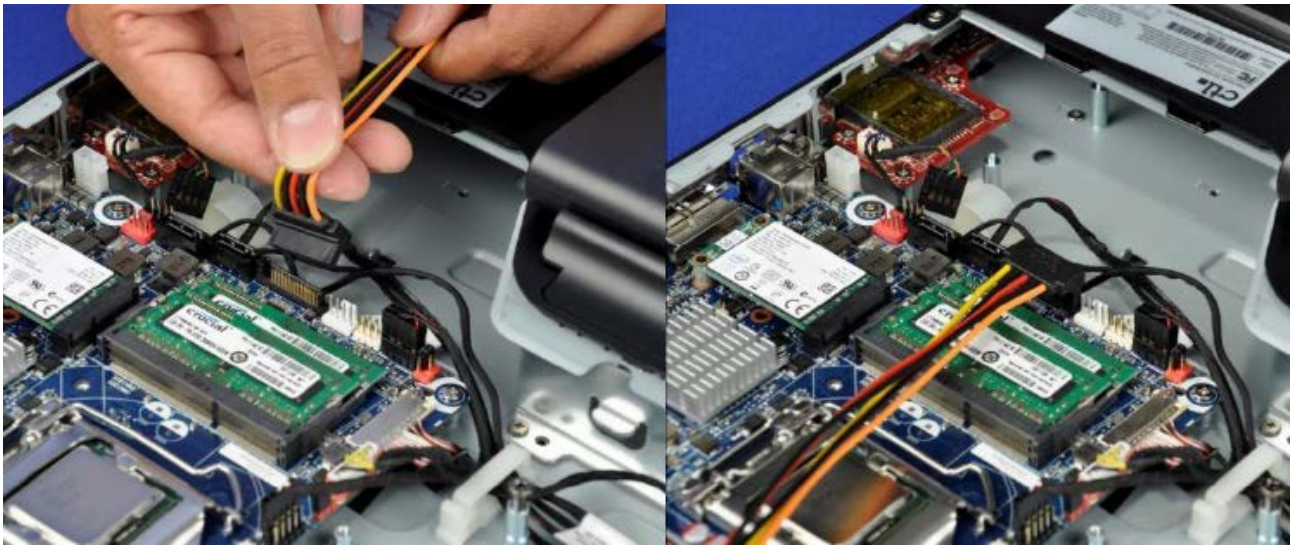
Slim optical drive

Connect the combo SATA power and data cable for the slim optical drive.



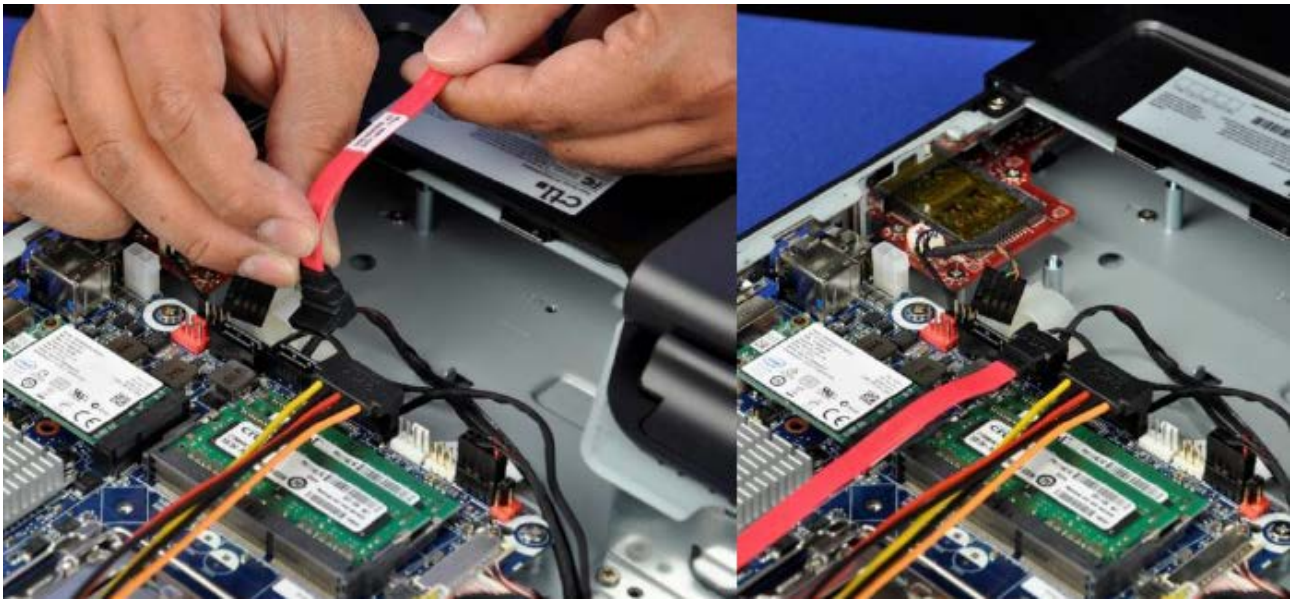
SATA power cable

A SATA power cable ships with the Intel Desktop Board DH61AG board and will power both the hard disk drive (or SSD) and an optical drive. The L-shaped connector connects to the board.



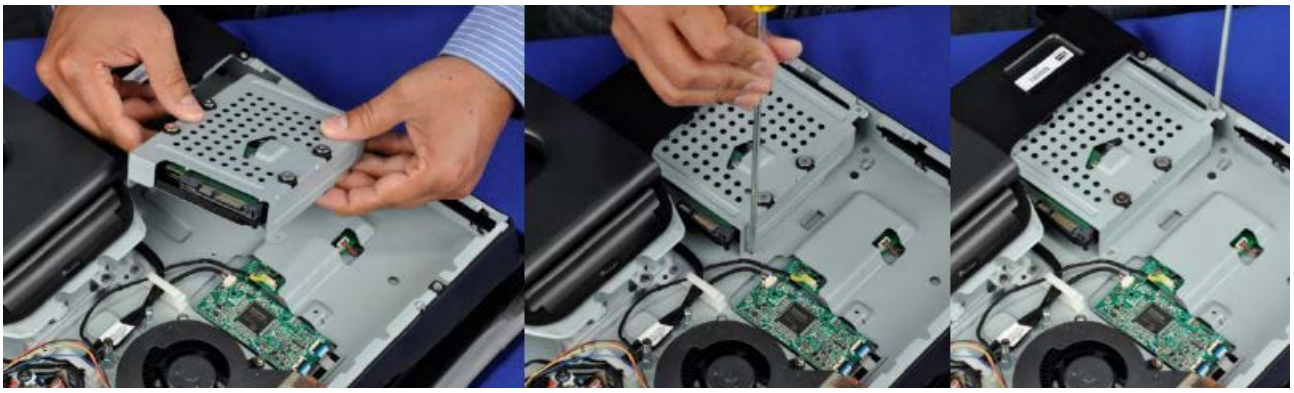
SATA data cable

A SATA data cable ships with the Intel Desktop Board DH61AG board and should be used for the hard disk drive (or SSD). Connect the L-shaped connector to either of the two SATA data ports on the board.



Installing a 3.5" hard drive

If you are using a 3.5" drive instead of an mSATA SSD: slide the drive into the cage and then secure it with the included four screws. Place the drive assembly on the chassis pan at an angle so it slides under the back plastic panel. Align the screw holes for the drive cage and then screw in the two screws provided to hold the cage to the chassis pan.

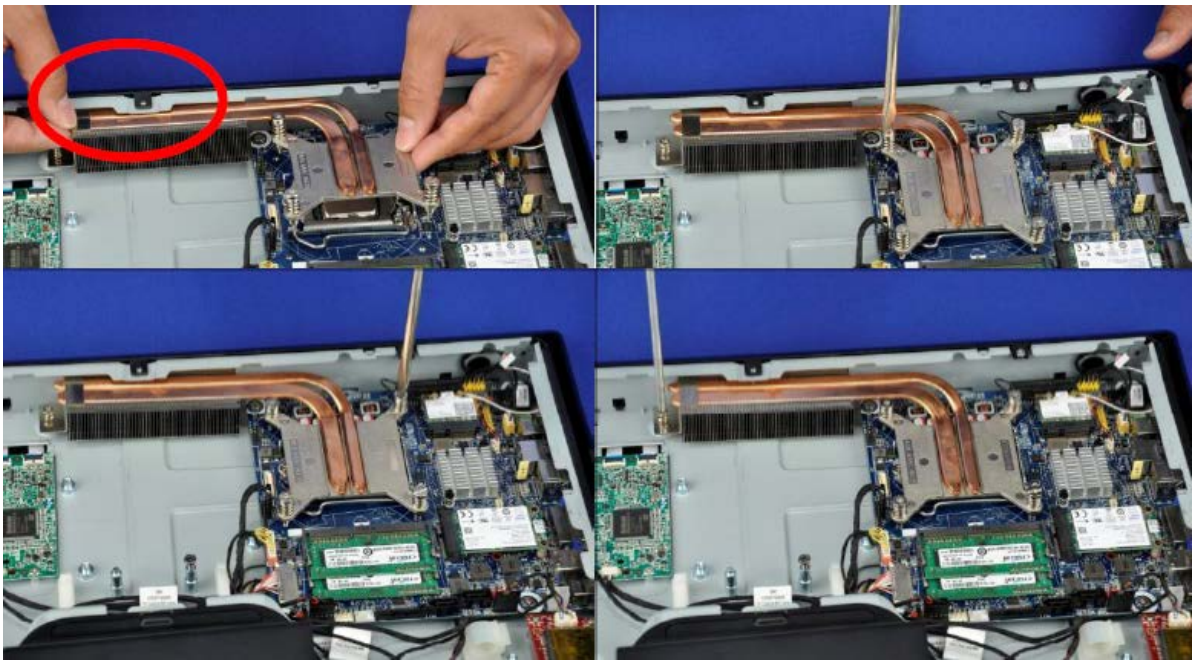


Plug in a 3.5" hard drive

Plug the SATA power and SATA data cable coming from the motherboard to the back of the drive. Route the cables in a way that they can be pressed down when the back cover is screwed in.

Integrate the thermal solution

Apply the thermal interface material (TIM) to the processor. Place the heatsink into position, aligning the board and chassis attach at the same time. Then screw the four thermal solution screws in a Z-pattern. Note: the thermal solution goes under the chassis edge (circled)



Integrate the processor blower

Finish the thermal solution integration by securing the heat exchanger to the chassis with one screw. Then place the blower in the chassis, aligning its three screw holes. Make sure no wires are trapped under the blower.

Plug in the blower

Plug the 4-wire cable from the blower to the white processor fan header on the board next to the SATA power port. The fan is PWM-controllable and has a fan tach signal output wire. The fan speed ranges from 1180 – 3380 RPM.

Finalize the integration

Before the back cover is closed, make sure the I/O shield of the Intel Desktop Board DH61AG board has not got any metal tabs stuck in the ports and the cables inside the chassis are properly routed, especially the optical drive power connector which is a large 4-pin Molex connector and can obstruct the back cover.

6.4 Configuring the BIOS

To simplify flat panel configurations, LVDS is enabled by default in BIOS (panel settings: 1920x1080, dual-channel, 24bpp) in the following circumstances:

Intel Desktop Board	BIOS version	Board revision
DH61AGL	0011 and later (all versions)	G71256-202 and later (all revisions)
DQ77KB	0036 and later (all versions)	G40294-402 and later (all revisions)
DH61AG	0040 and later	G23736-504 and later
DN2800MT	0158 and later	G23738-802 and later

Warning
Incorrect selection of an AIO chassis may result in incorrect operation or potential damage to AIO chassis hardware.

To select your AIO chassis in BIOS setup:

1. During boot, enter the BIOS setup by pressing **F2**.
2. Go to the **Configuration** > **Video** menu.
3. In the **All-in-One Chassis** option, select your chassis vendor/model.
4. Press **F10** to save and exit BIOS setup.

Selecting a pre-programmed chassis model automatically maps all the necessary values for that chassis.

Intel recommends locking the configuration once an AiO chassis is selected to avoid users disabling a working AIO system.

To lock the LVDS configuration:

1. During boot, enter the BIOS setup by pressing **F2**.
2. Go to the **Configuration** > **Video** > **Advanced Flat Panel Display Settings** menu.
3. Set **Flat Panel Configuration Changes** to **Locked**.
4. Press **F10** to save and exit BIOS setup.

Once a configuration is locked, it can only be unlocked in either of the following two methods:

- In Maintenance Mode, on the **Configuration** > **Video** > **Advanced Flat Panel Display Settings** menu.
- With Intel® Integrator Toolkit, using the **itoolkit remove –config** command.

See Appendix B for details on unlocking an LVDS configuration.

Appendix A: mini-ITX boards with LVDS

Several Intel Desktop Boards in the mini-ITX form factor include LVDS support. However, these are full-height boards and do not fit into All-in-One chassis systems.

Table 13: min-ITX boards with LVDS support

Intel® Desktop Board	Documentation
D2700MUD	TPS
D2550MUD2	TPS
D2500CC	TPS
D525MWV	TPS, Spec Update
D425KTW	TPS, Spec Update
D510MOV	TPS, Spec Update
D945GSEGT	TPS, Spec Update

Intel® Desktop Boards D2700MUD and D2550MUD2

Figure 5 shows the locations of the LVDS connectors and headers on the Intel Desktop Boards D2700MUD and D2550MUD2.

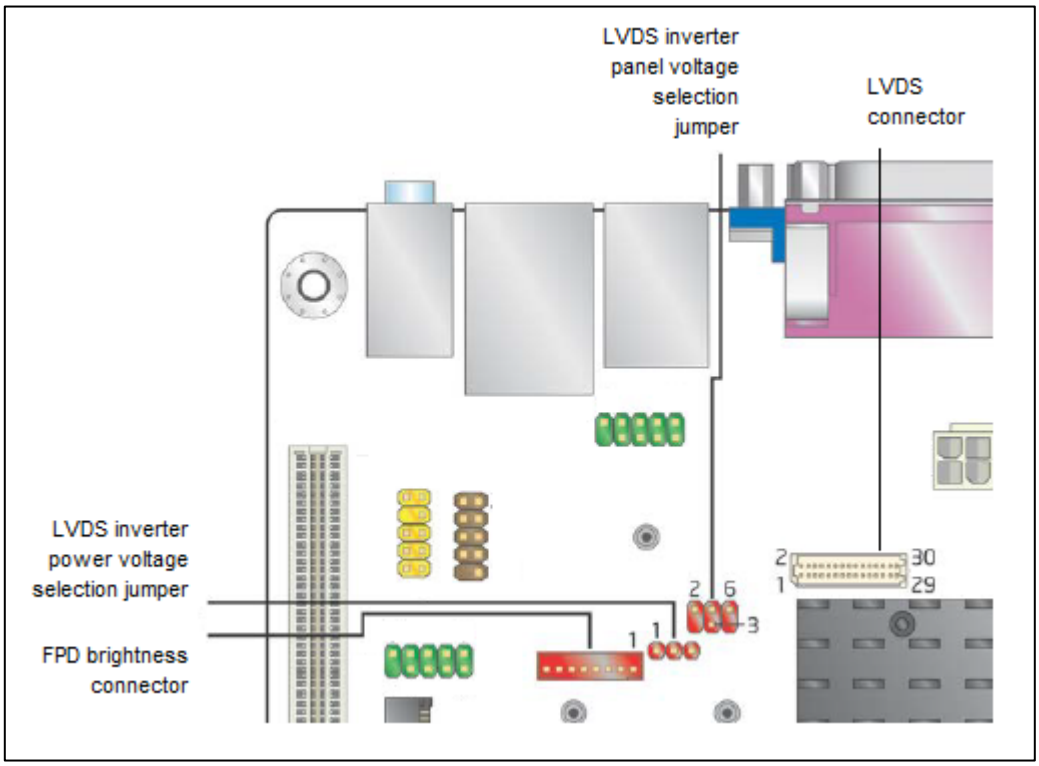


Figure 5: LVDS connectors and headers for Intel Desktop Boards D2700MUD and D2550MUD2

Intel® Desktop Board D2500CC

Figure 6 shows the locations of the LVDS connectors and headers on the Intel Desktop Board D2500CC.

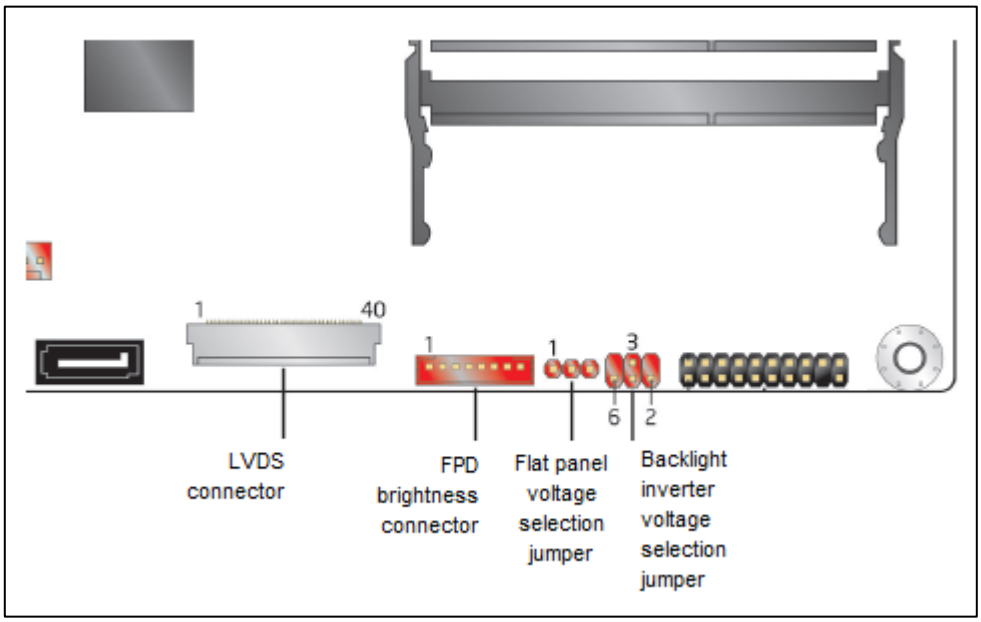


Figure 6: LVDS connectors and headers for Intel Desktop Board D2500CC

Intel® Desktop Board D525MWV and D425KTW

Figure 7 shows the locations of the LVDS connectors and headers on the Intel Desktop Boards D525MWV & D425KTW.

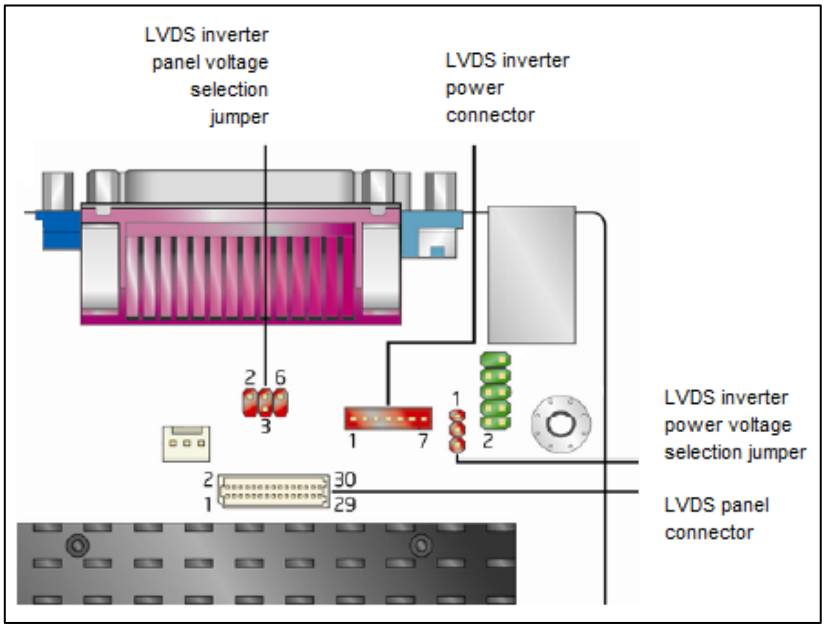


Figure 7: LVDS connectors and headers for Intel Desktop Boards D525MWV and D425KTW

Intel® Desktop Board D510MOV

Figure 8 shows the locations of the LVDS connectors and headers on the Intel Desktop Board D510MOV.

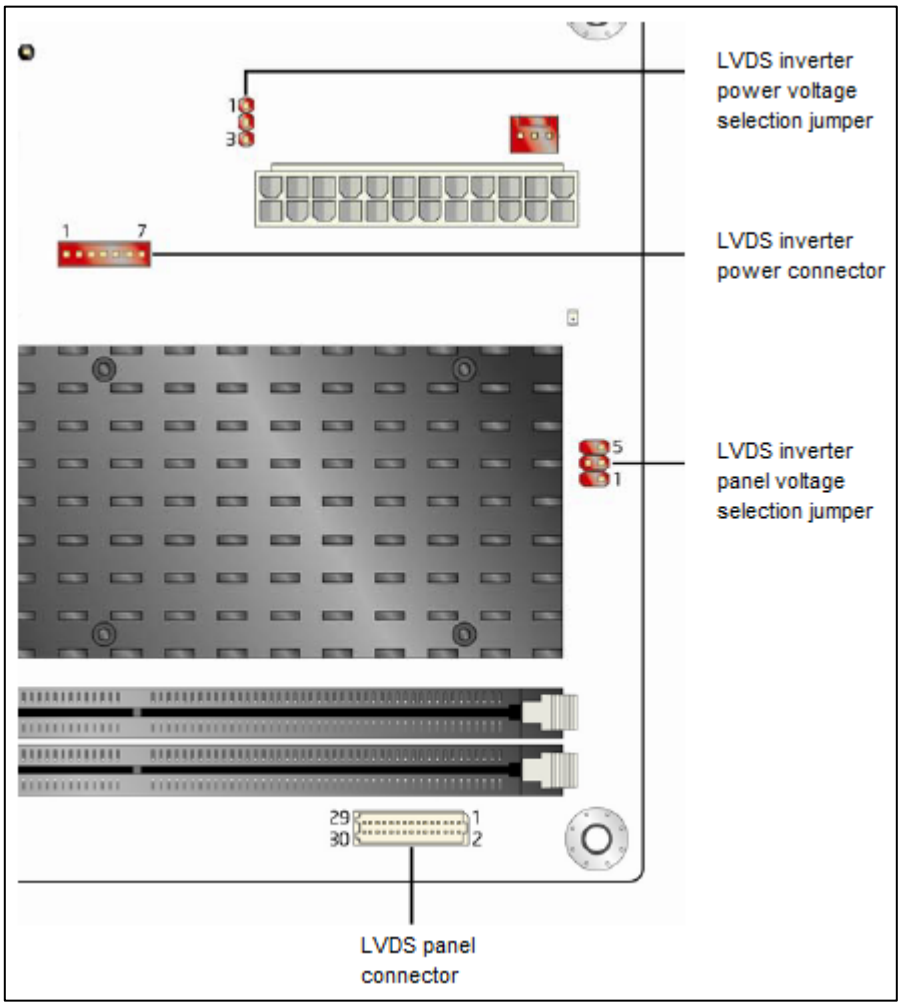


Figure 8: LVDS connectors and headers for Intel Desktop Board D510MOV

Intel® Desktop Board D945GSEGT

Figure 9 shows the locations of the LVDS connectors and headers on the Intel Desktop Board D945GSEJT.

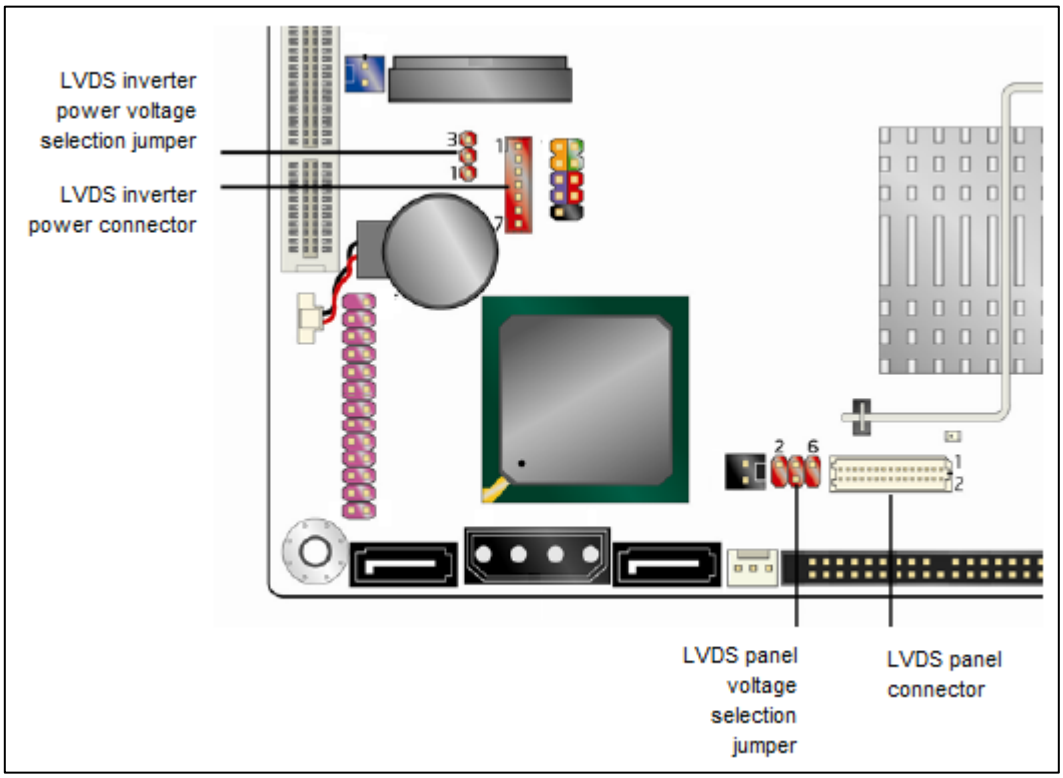


Figure 9: LVDS connectors and headers for Intel Desktop Board D945GSEJT

Appendix B: Unlocking an LVDS configuration

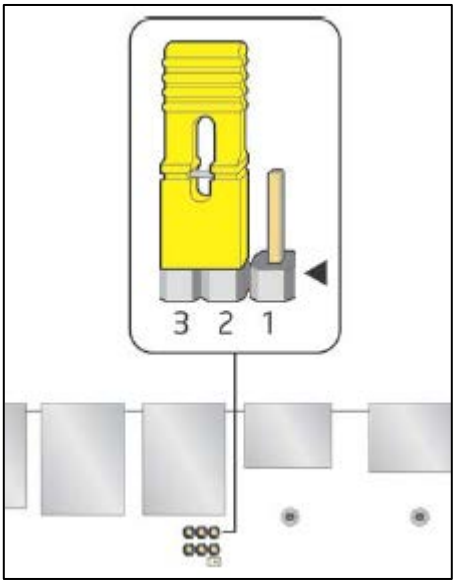
Once an LVDS configuration is locked, it can only be unlocked by one of the following two methods:

Using Maintenance Mode

The board boots into Maintenance Mode automatically when the Configuration jumper is set for Configure.

Follow these steps to unlock an LVDS configuration using Maintenance Mode.

1. Power off the computer and disconnect AC power.
2. Open the AIO chassis for access to the desktop board.
3. Locate the configuration jumper and move the jumper to pins 2 and 3.



4. Reapply AC power and turn on the computer.
5. When the BIOS setup appears, go to the **Configuration** > **Video** > **Advanced Flat Panel Display Settings** menu.
6. Set **Flat Panel Configuration Changes** to **Unlocked**.
7. Press **F10** to save and exit BIOS setup.
8. Power off the computer and disconnect AC power.
9. Move the jumper back to pins 1 and 2.
10. Replace the chassis cover.
11. Reapply AC power and turn on the computer.

Using Intel® Integrator Toolkit

1. Download and install Intel® Integrator Toolkit software.
2. Copy the file **itoolkit.exe** from the folder **\Program Files\Intel\Intel Integrator Toolkit\Installation Tool – DOS** to a DOS-bootable USB drive (or DOS box from Windows).
3. Run the following command: **itoolkit remove -config**