

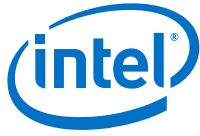
**Intelligent  
Systems**

# **Using Dual Displays During Startup or in DOS**

**Application Note**

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*August 2012*



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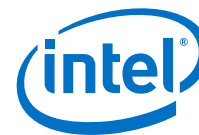
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## Revision History

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Date	Revision	Description
August 2012	001	Initial release



## 1.0 Introduction

This application note discusses using two displays running under DOS or when booting into an OS such as Windows or Linux. This document explains the issues with pre-OS dual displays and provides workarounds to address the situation using step-by-step examples. Dual display is allowed in DOS on Twin and Clone modes which are described in [“Example: Enabling Clone Mode for Dual Display”](#) and [“Example: Enabling Twin Mode with LVDS and CRT”](#).

## 2.0 Terminology

To be completely technically accurate, most likely we are talking about Clone mode, not Twin mode. To understand the difference between these two modes it is helpful to understand the graphics “three P’s” – Planes, Pipes and Ports.

A “plane” refers to an area of graphics memory allocated to hold the data that needs to be displayed. The display’s frame buffer memory is a “plane,” as are the overlay plane, sprite plane, hardware cursor plane, etc.

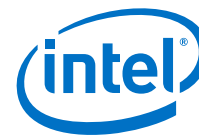
A “pipe” is the data pipeline that gets the display data from the plane to the display technology (the “port”). The pipe establishes structure to the raw data from the plane and establishes the timing of the data appropriate to display. The pipe also handles getting data from the various planes that may need to be displayed in the proper order such as the main framebuffer until it needs to get data from the overlay plane to display video data, then back to the framebuffer, then the cursor plane, etc. The pipe handles all this switching around seamlessly and without CPU or GPU intervention. It is a “set and forget” type of capability and the right data is displayed in the correct place once it is set correctly.

We also need to understand some other display terminology, i.e., Twin and Clone, as they are subtly different. Both display the same data on two displays attached to their ports. Because the ports share the same pipe, Twin has the restriction that the second display must have the identical display properties as the first (resolution, timing, etc.) which is rarely the case in the real world. Most customers want the flexibility of using different display resolutions and timing with their two displays. Clone makes use of the chipset’s second pipe to display the data from the primary display plane to a secondary display. This allows the second display to have a different resolution and/or timings as is usually necessary.

### 2.1 Pipe Limitations

Many of the built-in display ports on Intel chipsets available now (such as LVDS, eDP, etc.) have a restriction, by design, that does not allow them to share their pipe with another port. Thus, by definition, you cannot Twin them, and must Clone them which tends to be what is needed anyway.

Clone (or Twin) does not work in a fully compatible DOS mode. There are a number of factors at play here. First, DOS was never designed to be able to understand the concept of a second display. Because of that, dual display in DOS mode must be done invisibly without impacting the next factor, which is compatibility. DOS mode does not enjoy the wide range of “standardized” display handling and features that modern operating systems provide. Because of that, to enable “advanced” features in a DOS environment meant doing things yourself directly with the hardware. This means that for DOS and VGA to work, you need to assume your hardware is as VGA hardware compatible as possible.



Intel graphics engines do this by disabling the advanced features of the graphics engine when in VGA mode. If you are using a VGA mode (like mode 3 or 7 that just about every BIOS puts the system into at boot), the hardware is in that “VGA Compatible Hardware” mode and thus the extended features of the chipset (like the second PIPE to enable the second display in CLONE, and/or the display muxing units to direct a single pipe to two ports in TWIN) are unavailable. This is done to assure VGA compatibility as much as possible in response to the necessity of being compatible with DOS as fully as possible.

### 3.0 Example: Enabling Clone Mode for Dual Display

One alternative to enable dual display in DOS with Clone mode requires “High Resolution” mode. Clone mode should work on most display port configurations. The Video BIOS checks to see whether the requested mode is VGA or high resolution and makes a decision to enable dual display depending on the result and the available displays. VGA modes include modes 0 through 13h. High resolution modes include VESA modes.

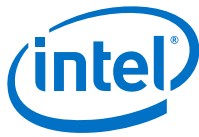
For this implementation, you can have the BIOS vendor change the mode set at boot to be a VESA mode or opt to boot DOS and have the AUTOEXEC.bat set the mode to the appropriate VESA mode.

The procedure below is one way to set a high resolution mode to enable dual display Clone with DOS. This is not the only possible way, however, it serves as an example to prove functionality. Individual implementation may vary depending on the needs of the design.

1. Write a .com file to set high res. mode as below  
e.g. for setting 640x480, 8bpp high res. mode:
  - a. Run the DOS debug.
  - b. Assemble this code using:  
N mode30.com [press **ENTER**]  
A [press **ENTER**]  
Mov ax, 30 [press **ENTER**]  
Int 10 [press **ENTER**]  
Int 20 [press **ENTER**]  
[press **ENTER**]  
RCX [press **ENTER**]  
20 [press **ENTER**]  
Q [press **ENTER**]
2. Edit the existing autoexec.bat and add the following line or create a new one with the following line:  
mode30.com

Place the Autoexec.bat file in the root directory so it is executed at boot time. In this example mode30.com is being called by the autoexec.bat. As soon as DOS boots, it sets the high res. mode (executing the lines in autoexec.bat) and displays will come up in clone.

The mode30.com file uses Interrupt 10 to set mode 30 which is 640x480, 8bpp high resolution mode.



These examples only call out Mode 30, 640x480 however you can use any one of the supported modes. These examples are only examples and do not imply that this is the only way to go about setting the appropriate mode for dual display at DOS. These examples are given as a proof of concept or functionality examples.

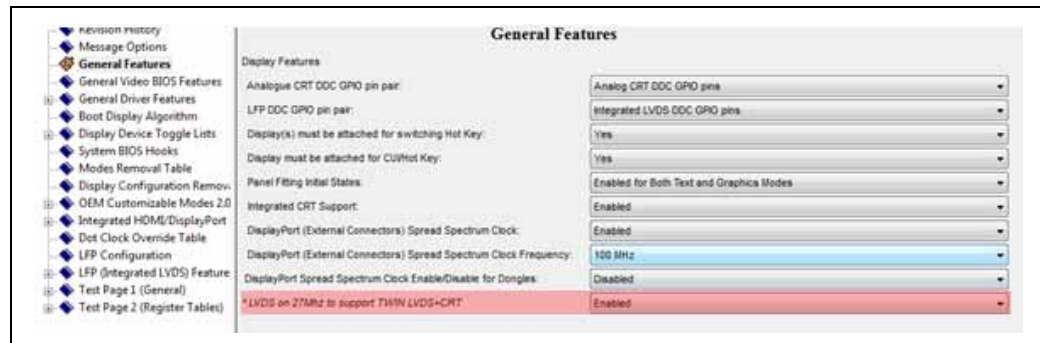
Otherwise, you can execute `mode30.com` during runtime to change your display to Clone if you choose not to include it in `AUTOEXEC.bat`. Furthermore, there is a `SETMODE.exe` program that is commonly available that allows you to set VESA mode to any mode with CLI such as "setmode 030" in DOS.

## 4.0 Example: Enabling Twin Mode with LVDS and CRT

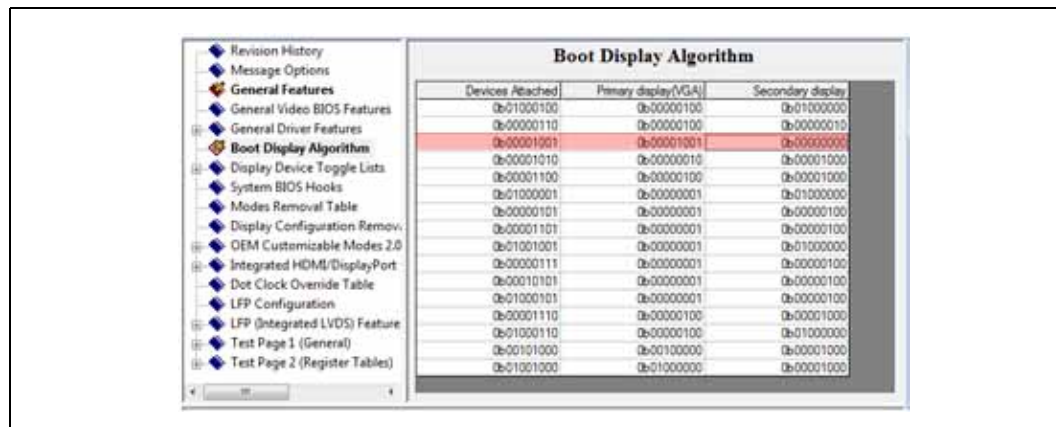
The scenario illustrates using dual display, for example, the user will expect display of command line interface in DOS mode when both screen of LVDS and VGA is connected. However, due to display pipe limitation in the chipset and design restriction, dual display support in DOS mode is not fully compatible in Intel® Atom™ Processor N2000 and D2000 Series.

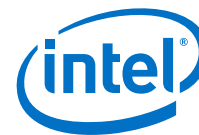
Dual display is allowed using POST and DOS in Twin mode when CRT and LVDS are utilized. Twin mode in DOS is made possible by configuring vBIOS in BMP tool with the settings shown below.

1. Set "LVDS on 27MHz to support TWIN LVDS+CRT" to "Enabled":



2. Configure the Boot Display Algorithm:
  - Device Attached = 0b00001001
  - Primary Display = 0b00001001
  - Secondary Display = 0b00000000





It is important to set the secondary display as “none” and LVDS and CRT bits are defined in the primary display.

*Note:* Twin setting works only on certain CRT monitors (internally tested on Dell\* 2408WFP and Dell\* U2711).

Both displays should display in Twin mode after Video BIOS is configured and merged with the appropriate system BIOS upon system boot up.

## 5.0 Typical Questions and Answers

**Question 1:** I've seen some system boot DOS with two displays. How is that possible?

**Answer:** Some VBIOS have been designed to use a less compatible technique of ignoring the mode set and to use a VESA mode instead of the requested VGA mode to allow two displays to work. The embedded VBIOS have never done this because of compatibility risks and code space restrictions in the VBIOS code. Recently, some GMA drivers and VBIOS also have not implemented this workaround because their target use cases (tablet or cell phones) do not have a second display.

**Question 2:** What can I do to get my second display working?

**Answer:** There is a workaround for DOS. To have a possibility of enabling a second display, you can use a VESA mode from DOS. VESA modes are designed to be higher resolutions and enable more advanced features thus it allows more of the special features of the graphics engines to be enabled rather than needing to be more hardware compatible for VGA modes of operation. You can have your BIOS vendor change the mode set at boot to be a VESA mode, then DOS will have the ability to enable the second display. You can also opt to boot DOS and have your CONFIG.SYS or AUTOEXEC.BAT do a mode set to the appropriate VESA mode (see [“Example: Enabling Clone Mode for Dual Display” on page 5](#)). You can make sure your DOS program uses a VESA mode if you are an OEM developing your own DOS programs. VESA modes are typically 101h or higher. For embedded customers, it is best if you use the CORRECT VESA mode overtly so you are aware of exactly what the hardware is doing when you want to use both displays.

**Question 3:** What are the limitations?

**Answer:** This workaround does NOT fix things such as older DOS programs or Windows boot as those tend to use VGA mode 640 x 480 (mode 12h is most likely) and are more likely to need the VGA hardware compatibility operation. Although a customer may want the Windows boot to display on both screens, it is not possible; by design, it is not a feature of this particular chipset. Realistically, this is not a “show stopper” issue as one display does show the startup status. After a full OS (such as Windows or Linux) is up, the driver will be able to properly enable Clone (or Twin, or Extended, or Single) displays.

There is a SETMODE program that is commonly available that allows you to set VESA modes, and the display configuration (i.e., Clone) that you can use. We may be able to make one available from Intel as we have done in the past. It also may already be in the VBIOS build package as CED creates.

