WHITE PAPER

April 2001

Prepared by

Access Business Group
Commercial Notebook
Division

Compaq Computer
Corporation

CONTENTS

Choosing a Display to Meet your Notebook Computing Needs

EXECUTIVE SUMMARY

When purchasing a notebook computer, there are a few key decisions to ensure it will best suit your needs. Those decisions are display type, screen size and resolution. It is important to understand the advantages and disadvantages of the displays being offered before making that decision.

Compaq has carefully selected optimal panel choices that suit a wide range of customer goals in notebook computing. This paper seeks to explore the choices available, explain the benefits of each, and provide tools to help in the decision making process when purchasing your next notebook computer.

LIQUID CRYSTAL DISPLAYS (LCDS)

There are two main types of Liquid Crystal Displays (LCDs) used in notebook computers – passive matrix and active matrix. Each display is made up of a grid of conductors that creates individual pixels A pixel is the lowest addressable 'picture element' comprised of individually controlled red, green, and blue (RGB) sub-elements commonly referred to as "dots".

Passive matrix displays are often referred to as STN (Super Twisted Nematic). Electrodes at the edges of the display address the STNs. Pixels are activated when sufficient voltage from the electrodes turns the pixel "on". The response time is much slower than that of active matrix-based displays, and the overall picture quality is far below that of active matrix-based displays. However, these displays are easier to manufacture, and thus traditionally have been less expensive. Due to recent market conditions and an explosion of active matrix production capability, STN production and new product development has almost ceased.

Active matrix displays have thin film transistors (TFTs) at each RGB dot to act as an electronic switch actively controlling the individual characteristics of each dot. Active matrix displays provide much faster response time, as well as greater contrast resulting in wider viewing angles.

Regardless of LCD panel type, selecting a panel also requires the right balance of resolution and panel size for the users end application.

RESOLUTION

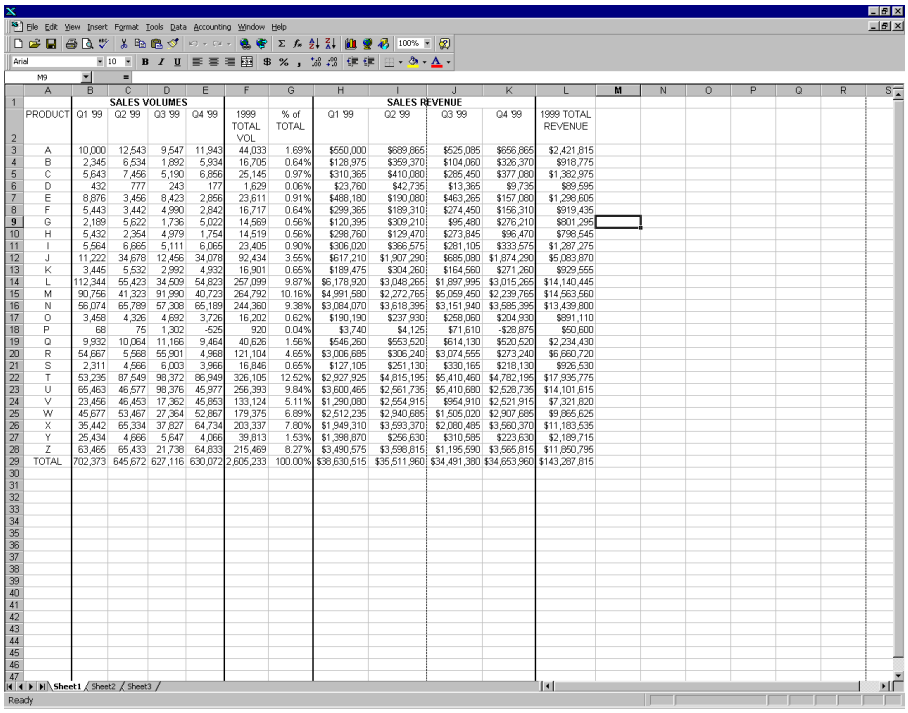
Resolution is a function of the sharpness or detail of an image. It is often referred to as the number of pixels displayed in a row by column arrangement. Below is a list of the most common resolution standards typically used with notebook computers.

STANDARD	DESCRIPTION	RESOLUTION
SVGA	Super Video Graphics Array	800 x 600
XGA	Extended Graphics Array	1024 x 768
SXGA+	Super Extended Graphics Array Plus	1400 x 1050
UXGA	Ultra XGA	1600 x 1200

Note: The SXGA+ (1400 x 1050) for notebook displays differs slightly from the SXGA (1280 x 1024) format used by monitors.

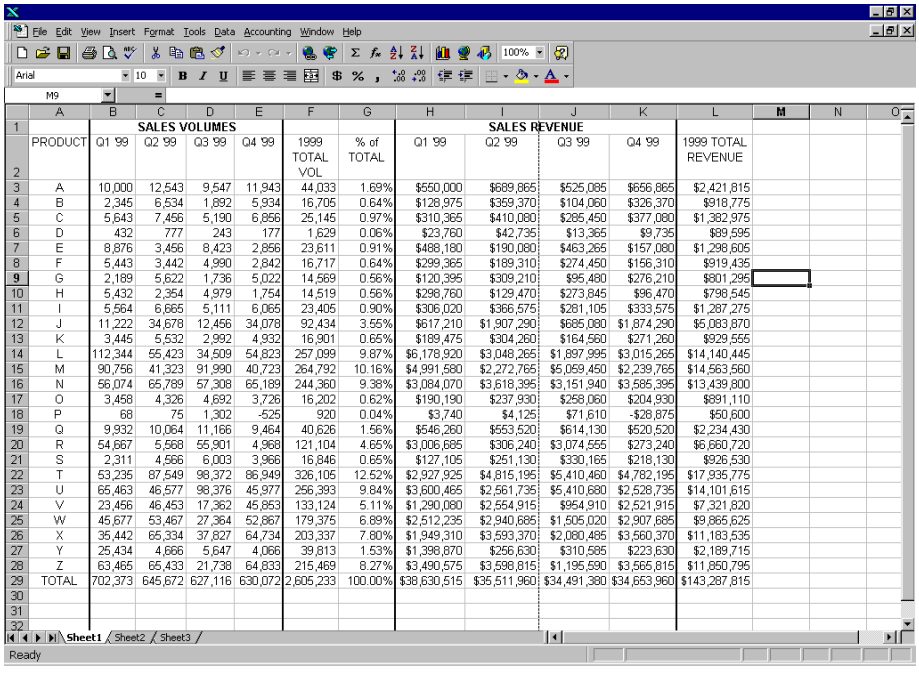
Higher resolutions allow more information to be displayed on the screen. This can be particularly important when trying to view large amounts of data at one time. To illustrate this point, the following Microsoft Excel spreadsheet depicts the relative quantity of data that can be viewed at one time using different resolutions. With each increase in resolution, the relative cell height and width does not change, however, the amount of information (number of cells) that can be viewed on the screen at one time is significantly larger.

Resolution 1400 x 1050 (SXGA+) 18.5 x 47 cells



	A	B	C	D	E	F	G	H	I	J	K	L
1		SALES VOLUMES						SALES REVENUE				
2	PRODUCT	Q1 '99	Q2 '99	Q3 '99	Q4 '99	1999 TOTAL VOL	% of TOTAL	Q1 '99	Q2 '99	Q3 '99	Q4 '99	1999 TOTAL REVENUE
3	A	10,000	12,543	9,547	11,943	44,033	1.69%	$550,000	$689,865	$525,085	$656,865	$2,421,815
4	B	2,345	6,534	1,892	5,934	16,705	0.64%	$128,975	$359,370	$104,060	$326,370	$918,775
5	C	5,643	7,456	5,190	6,856	25,145	0.97%	$310,365	$410,080	$285,450	$377,080	$1,382,975
6	D	432	777	243	177	1,629	0.06%	$23,760	$42,735	$13,365	$9,735	$89,595
7	E	8,876	3,456	8,423	2,856	23,611	0.91%	$488,180	$190,080	$463,265	$157,080	$1,298,605
8	F	5,443	3,442	4,990	2,842	16,717	0.64%	$299,365	$189,310	$274,450	$156,310	$919,435
9	G	2,189	5,622	1,736	5,022	14,569	0.56%	$120,395	$309,210	$95,480	$276,210	$801,295
10	H	5,432	2,354	4,979	1,754	14,519	0.56%	$298,760	$129,470	$273,845	$96,470	$798,545
11	I	5,564	6,665	5,111	6,065	23,405	0.90%	$306,020	$366,575	$281,105	$333,575	$1,287,275
12	J	11,222	34,678	12,456	34,078	92,434	3.55%	$617,210	$1,907,290	$685,080	$1,874,290	$5,083,870
13	K	3,445	5,532	2,992	4,932	16,901	0.65%	$189,475	$304,260	$164,560	$271,260	$929,555
14	L	112,344	55,423	34,509	54,823	257,099	9.87%	$6,178,920	$3,048,265	$1,897,995	$3,015,265	$14,140,445
15	M	90,756	41,323	91,990	40,723	264,792	10.16%	$4,991,580	$2,272,765	$5,059,450	$2,239,765	$14,563,560
16	N	56,074	65,789	57,308	65,189	244,360	9.38%	$3,084,070	$3,618,395	$3,151,940	$3,585,395	$13,439,800
17	O	3,458	4,326	4,692	3,726	16,202	0.62%	$190,190	$237,930	$258,060	$204,930	$891,110
18	P	68	75	1,302	-525	920	0.04%	$3,740	$4,125	$71,610	-$28,875	$50,600
19	Q	9,932	10,064	11,166	9,464	40,626	1.56%	$546,260	$553,520	$614,130	$520,520	$2,234,430
20	R	54,667	5,568	55,901	4,968	121,104	4.65%	$3,006,685	$306,240	$3,074,555	$273,240	$6,660,720
21	S	2,311	4,566	6,003	3,966	16,846	0.65%	$127,105	$251,130	$330,165	$218,130	$926,530
22	T	53,235	87,549	98,372	86,949	326,105	12.52%	$2,927,925	$4,815,195	$5,410,460	$4,782,195	$17,935,775
23	U	65,463	46,577	98,376	45,977	256,393	9.84%	$3,600,465	$2,561,735	$5,410,680	$2,528,735	$14,101,615
24	V	23,456	46,453	17,362	45,853	133,124	5.11%	$1,290,080	$2,554,915	$954,910	$2,521,915	$7,321,820
25	W	45,677	53,467	27,364	52,867	179,375	6.89%	$2,512,235	$2,940,685	$1,505,020	$2,907,685	$9,865,625
26	X	35,442	65,334	37,827	64,734	203,337	7.80%	$1,949,310	$3,593,370	$2,080,485	$3,560,370	$11,183,535
27	Y	25,434	4,666	5,647	4,066	39,813	1.53%	$1,398,870	$256,630	$310,585	$223,630	$2,189,715
28	Z	63,465	65,433	21,738	64,833	215,469	8.27%	$3,490,575	$3,598,815	$1,195,590	$3,565,815	$11,850,795
29	TOTAL	702,373	645,672	627,116	630,072	2,605,233	100.00%	$38,630,515	$35,511,960	$34,491,380	$34,653,960	$143,287,815

Resolution 1024 x 768 (XGA) 14.5 x 32 cells



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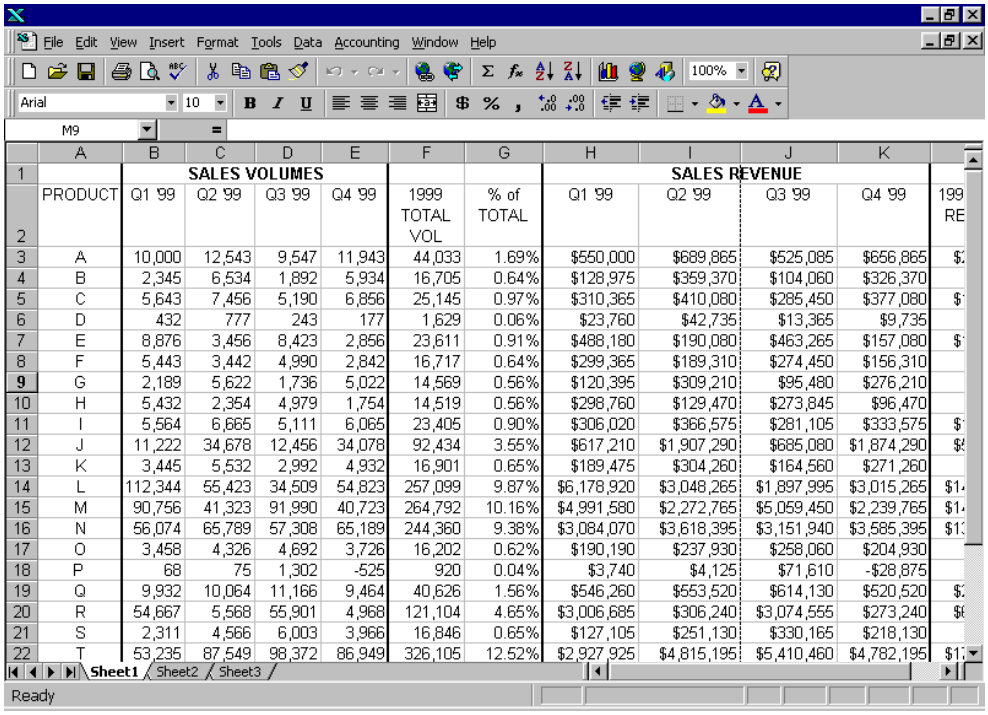
Resolution 800 x 600 (SVGA) 11.5 x 22 cells



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21	S	2,311	4,566	6,003	3,966	16,846	0.65%	$127,105	$251,130	$330,165	$218,130	
22	T	53,235	87,549	98,372	86,949	326,105	12.52%	$2,927,925	$4,815,195	$5,410,460	$4,782,195	$1

It is important to note that a larger number of pixels displayed on the same size screen will result in smaller pixel size. Windows icons and title bars are the same number of pixels despite the resolution, so the higher the screen resolution, the smaller they appear. For this reason, higher resolutions typically look better on physically larger screens where the pixels are correspondingly larger. However, Microsoft Windows 95 and later does allow the user to modify font sizes for menu bars and dialog boxes. In addition, several third party vendors offer software that allows users to scale windows for optimum viewing regardless of resolution.

Higher resolutions typically suit users that must view large amounts of data at one time, run multimedia applications, run multiple graphics or spreadsheet programs, or simply prefer the look and feel of a crisp display.

PANEL SIZE

What if you held resolution constant and varied the size of the panel? For example, a 13", 14" and 15" panel with XGA resolution will display the same number of pixels (1024 x 768) and hence same amount of information on the screen. However as the panel size increases, the dot pitch (distance between pixels) also increases reducing clarity and continuity of the image.

As panels increase in size, the resolution (maximum pixels) should also increase. The following table outlines some ideal resolution/panel size combinations for optimal viewing.

	12"	13.3"	14.1"	15.0"
SVGA	X	X		
XGA	X	X	X	X
SXGA+			X	X

OTHER CONSIDERATIONS

There are several other things to take into account when evaluating panel sizes and resolution.

Weight – as panel size increases, so does weight of the panel, adding to the overall weight of the unit. Although this may not be substantial, high mobility users might prefer to stick with a smaller panel size to maximize mobility. Conversely, users that rely on their notebook as a primary productivity tool may consider weight an easy tradeoff for the advantages that a larger panel affords them. However, in a notebook model family that has multiple panel size offerings, the increased weight from one size to the next can be negligible. For example, minimum weight of an Armada E500 with a 13.3" or 14.1" panel is 5.7lb and 5.9lb respectively.

Power consumption – The larger the panel and greater the resolution the more power required to achieve optimal viewing. This is of particular consideration for mobile users who rely heavily on battery power, but again the relative differences in power consumption from one panel to the next can be quite small.

Usage – Users that require notebook mobility for travel purposes might view the cramped quarters in a plane or limited space in carry-on luggage as a primary concern for choosing the ideal size of their notebook panel. Conversely, users for whom the notebook is a desktop replacement will consider ergonomics and usability as a primary factor.

Color – Each pixel is made up of a combination of three different color signals (red, green, blue). The appearance of each pixel is controlled by the intensity of these beams of light and the amount of information that is stored about a pixel determines its color. The more bits that are used per pixel (bit depth), the finer the detail of the image. All SVGA systems support the display of 16 million colors, but the number of colors displayed simultaneously is limited by the amount of video memory installed in a system.

Color Depth	Description	Number of colors	Bytes per pixel
4-bit	Standard VGA	16	0.5
8-bit	256-color mode	256	1.0
16-bit	High color	65,536	2.0
24-bit	True color	16,777,216	3.0

SUMMARY

Compaq strives to offer customers optimal choices for notebook computing displays by considering what customers need. With each notebook in the Armada line, panel size and resolution is carefully considered for applicability and customer satisfaction. Following is a list of Notebook computers offered today and the corresponding panel options for each:

Armada Model	Application	Panel Options
M700	High performance in a thin and light design	13.3" XGA 14.1" XGA
M300	Ultra-portable	12.1" XGA 11.3" XGA
E500	All-in-one High performance	12.1" SVGA 13.3" XGA 14.1" XGA 15.0" SXGA+
110S	Ready to run, value conscious	12.1" SVGA 13.3" XGA

As with all technology, innovation is continuously providing new options for notebook panels. Compaq is at the forefront of innovation and continues to evaluate and provide the ideal panel solutions for our notebook customers.

NOTICE

The information in this publication is subject to change without notice.