INTERFACE & INTERCONNECTION FOR 4-INCH & 6-INCH TFT / LCDs

Alan Dragon, Field Applications Engineer

INTRODUCTION

Sharp Electronics Corporation has introduced a series of small TFT (Thin Film Transistor) LCD modules to be used in a wide range of video applications. These displays are well suited for use in Portable TV/VCR Entertainment Systems, Test/Control Equipment, Control and Entertainment displays for Aviation, along with Automotive, Navigational and Imaging Applicatons. The current product line-up includes diagonal sizes of 3", 4" and 5.7" (Table 2, page 2). With three formats available (234V x 32.5H, 234V x 720H, 240V x 720H), NTSC and PAL Video Standards can be supported by various models within the product line (Note 1). All 4" and 5.7" models are available with a 6 o'clock or a 12 o'clock viewing direction for optimum performance with any mounting orientation.

Sharp TFT LCDs use the normally white mode of operation for an excellent contrast ratio and superior color reproducibility. This is characterized by a contrast ratio of 30:1 with a light output of 120 nits (35 foot-lamberts). With these specifications, the TFT LCD modules can be used in various lighting environments.

The possibility of battery operation is enhanced by the low power consumption of the TFT display. Total power is typically 2.6 watts, with 1.7 watts of that total being consumed by the backlight.

VIDEO SIGNAL STANDARDS

NTSC/PAL

It will be useful to understand the video standards of NTSC and PAL before explaining the actual interface of the TFT displays. NTSC (National Television System Committee) and PAL (Phase Alternation Line) are two different color encoding methods for broadcasting or sending color video information. Most countries around the world have adopted one of these two standards. The remaining countries have adopted SECAM, which is based on the PAL Standard (Table 3). This application note will concentrate on the timing characteristics of the NTSC and PAL Standards and leave the explanation of color encoding and decoding methods up to video textbooks.

Note 1: The current product line reflects improvements made to earlier models (Table 1).

Table 1.
Transition from Prototype Models to Current Production Models

CURRENT MODEL	PROTOTYPE MODEL
LQ4RE01 NTSC/PAL 6 o'clock	LQ424Y02 [NTSC 6 o'clock] LQ424P01 [PAL 6 o'clock]
LQ4RA01 NTSC/PAL 6 o'clock	LQ424A01 [NTSC 6 o'clock] LQ6MA01 [PAL 6 o'clock]
LQ4RE02 NTSC/PAL 12 o'dock	LQ4NA02 [NTSC 12 o'clock] LQ4MA02 [PAL 12 o'clock]
LQ6RA01 NTSC/PAL 6 o'clock	LQ6NA01 [NTSC 6 o'clock] LQMA01 [PAL 6 o'clock]
LQ6RA02 NTSC/PAL 12 o'dock	LQ6NA01 [NTSC 12 o'clock] LQ6MA02 [PAL 12 o'clock]
LQ6RA02 NTSC/PAL 12 o'dock	LQ6NA02 [NTSC 12 o'clock] LQ6MA02 [PAL 12 o'clock]

The basic difference between NTSC and PAL is the number of lines per frame. NTSC uses 525 lines per frame at a 60 Hz field rate and PAL uses 625 lines per frame at a 50 Hz field rate (Table 4).

When an image is broken up into more horizontal lines, the resolution and image quality improve accordingly. Both standards consist of two interlaced fields. These two fields (designated odd and even) make up one full frame. The alternating odd and even fields make the actual frame rate 1/2 of the field rate (Figure 1). Although the two fields alternate, the human eye will superimpose and blend the odd and even fields to give the appearance of one continuous and flicker-free image.

Table 2.
Sharp's Small TFT Color LCD Modules

MODEL	DIAGONAL SCREEN SIZE (INCHES)	PIXEL FORMAT (V x H)	INPUT CAPABILITY	BACKLIGHT	VIEWING DIRECTION	EFFECTIVE VIEWING AREA (W x H) (mm)	DOT PITCH (W x H) (mm)	OUTLINE DIMENSIONS (W x H x L) (mm)	WEIGHT (GRAMS)	IN
LQ4RE01	4	234 x 479	NTSC/PAL	N/A	6 o'clock	81.9 x 61.8	0.171 x 0.264	122 x 100 x 6.6	135	N
LQ4RE02	4	234 x 479	NTSC/PAL	N/A	12 o'clock	81.9 x 61.8	0.171 x 0.264	122 x 100 x 6.6	135	N
LQ4RA01	4	234 x 479	NTSC/PAL	HCFT/Built-in	6 o'clock	81.9 x 61.8	0.171 x 0.264	110.2 x 85.8 x 20.7	170	A
LQ4RA02	4	234 x 479	NTSC/PAL	HCFT/Built-in	12 o'clock	81.9 x 61.8	0.171 x 0.264	110.2 x 85.8 x 20.7	170	A
LQ4NC01	4	234 x 479	NTSC	HCFT/Built-in	6 o'clock	81.9 x 61.8	0.171 x 0.264	110.2 x 85.8 x 20.7	180	C
LQ4NC02	4	234 x 479	NTSC	HCFT/Built-in	12 o'clock	81.9 x 61.8	0.171 x 0.264	110.2 x 85.8 x 20.7	180	C
LQ6RA01	5.7	240 x 720	NTSC/PAL	CCFT/Built-in	6 o'clock	113.8 x 87.6	0.158 x 0.365	149.4 x 117 x 23	310	A
LQ6RA02	5.7	240 x 720	NTSC/PAL	CCFT/Built-in	12 o'clock	113.8 x 87.6	0.158 x 0.365	149.4 x 117 x 23	310	A
LQ6NC01	5.7	240 x 720	NTSC	CCFT/Built-in	6 o'clock	113.8 x 87.6	0.158 x 0.365	149.4 x 117 x 23	320	C
LQ6NC02	5.7	240 x 720	NTSC	CCFT/Built-in	12 o'clock	113.8 x 87.6	0.158 x 0.365	149.4 x 117 x 23	320	C
LQ6MC01	5.7	240 x 720	PAL	CCFT/Built-in	6 o'clock	113.8 x 87.6	0.158 x 0.365	149.4 x 117 x 23	320	C
LQ6MC02	5.7	240 x 720	PAL	CCFT/Built-in	12 o'clock	113.8 x 87.6	0.158 x 0.365	149.4 x 117 x 23	320	C
LQ323Y11	3	234 x 382.5	NISC	N/A	6 o'clock	61.7 x 44.5	0.161 x 0.190	94.2 x 78.5 x 61	80	N
LQ323P07	3	234 x 382.5	PAL	N/A	6 o'clock	61.7 x 44.5	0.161 x 0.190	94.2 x 78.5 x 61	80	N

Note: All specifications are subject to change.

Table 3. International Television Standards

LINES PER FRAME: 525 FIELD RATE: 60 Hz COLOR CODING: NTSC	LINES PER FRAME: 625 FIELD RATE: 50 Hz COLOR CODING: PAL	LINES PER FRAME: 625 FIELD RATE: 50 Hz COLOR CODING: SECAM
Antiqua, West Indies	Algeria	Afars and Issas
Bahamas	Australia	Arab Republic of Egypt
Barbados	Austria	Bulgaria
British Virgin Islands	Bahrain	Czechoslovakia
Canada	Bangladesh	East Germany
Chile	Brunei	France
Costa Rica	Brazil (525/60)	Greece
Cuba	Denmark	Haiti
Dominican Republic	Federal Republic of Germany	Hungary
Ecuadoron Republic	Finland	Iran
El Salvador	Hong Kong	Ivory Coast
Guatemala	Iceland	Iraq
Japan	Ireland	Lebanon
Mexico	Italy	Luxembourg
Netherlands Antiles, West Indies	Jordan	Mauritius
Nicaragua	Kuwait	Monaco
Panama	Malaysia	Morocco
Peru	Netherlands	Poland
Phillipines	New Zealand	Reunion
St. Kitts, West Indies	Nigeria	Saudi Arabia
Samoa (U.S.)	Norway	Tunisia
Surinam	Oman	USSR
Province of Taiwan	Pakistan	Zaire
Trinidad, West Indies	Oatar	
Trust Territory of Pacific	Singapore	
United States of America	South Africa	
	Spain	
	Sweden	
	Switzerland	
	Tanzania	
	Thailand	
	Turkey	
	United Arab Emirates	
	United Kingdom	
	Yugoslavia	

Table 4. NTSC and PAL Timing Standards

NTSC	PAL
Lines / Frame: 525 Lines / Field: 262.5 Field Rate: 60 Hz Frame Rate: 30 Hz Display Period: 24 OH Horizontal Interval: 63.5 µs (1H) Vertical Interval: 16.7 ms (262.5H) Vertical Blanking: 1.42 ms (22.5H) Vertical Sync Pulse: 254 µs (4H)	Lines / Frame: 625 Lines / Field: 312.5 Field Rate: 50 Hz Frame Rate: 25 Hz Display Period: 28 OH Horizontal Interval: 64.0 µs (1H) Vertical Interval: 20.0 ms (312.5H) Vertical Blanking: 2.08 ms (32.5H) Vertical Sync Pulse: 256 µs (4H)

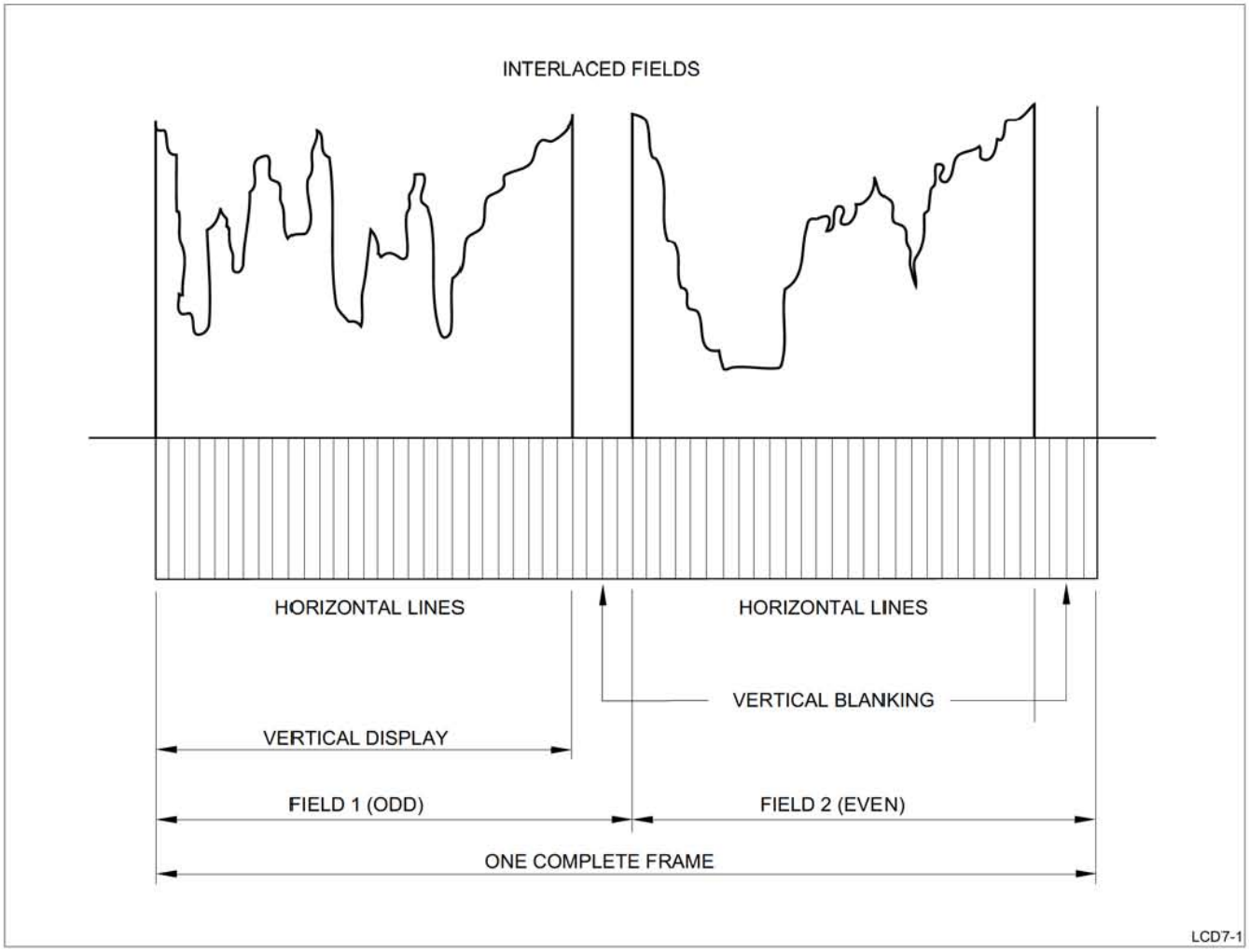

Fig. 1. Interlaced Fields

Composite/Non-Composite Video Signals

Video signals can be transmitted in a variety of formats. Sharp TFT LCD modules will support the following video configuration:

- Composite Video - Video information is combined with horizontal and vertical sync and color burst information into one signal (Figure 2).
- Analog RGB (non-composite)- Separate red, green and blue video signals used in conjuction with composite sync or separate horizontal and vertical sync (Figure 3).
- Composite Sync - Horizontal and vertical sync are combined into one signal (Figure 4).

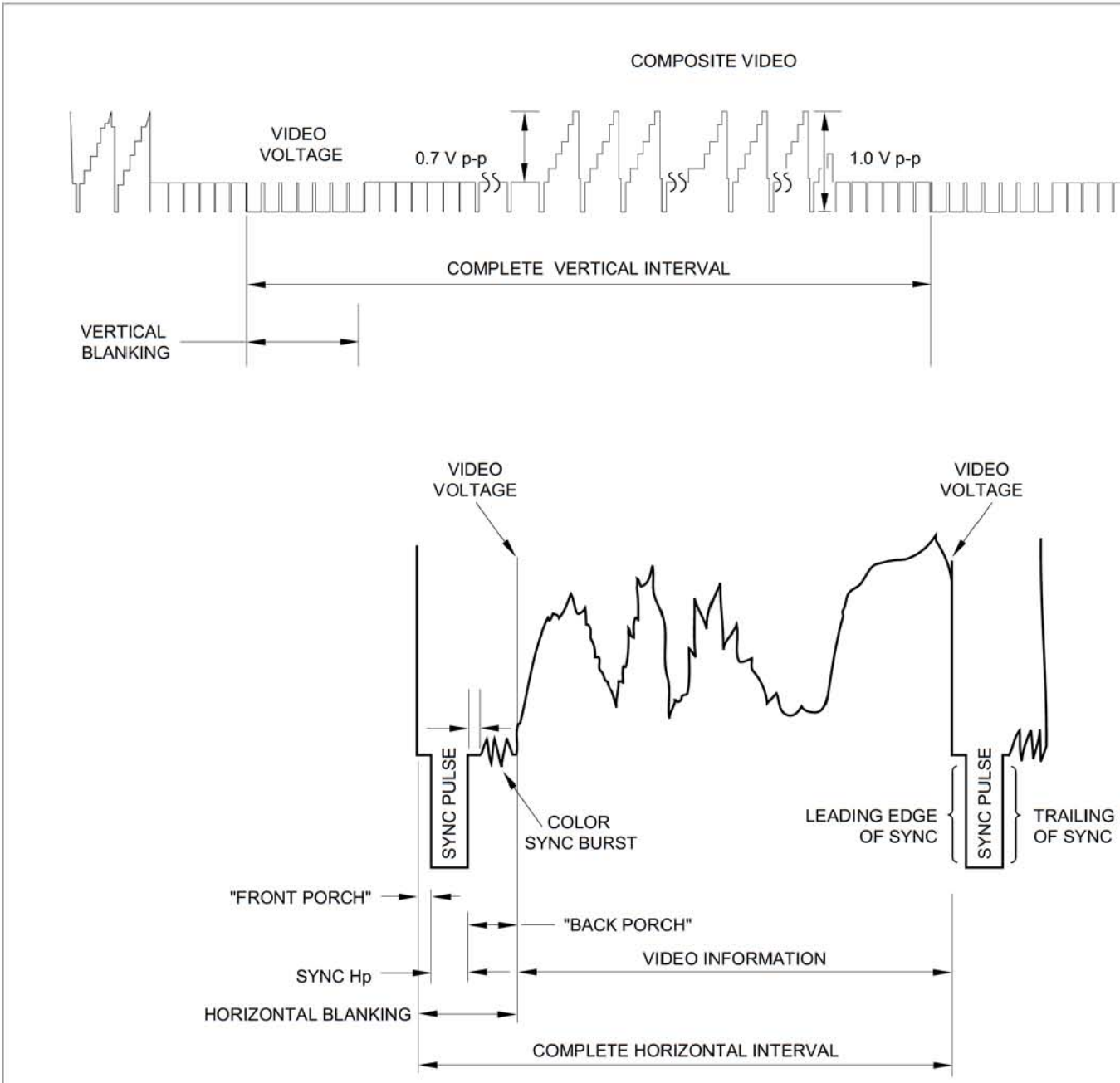

Fig. 2. Composite Video

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS
Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS
Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS
Sync your system to PACER to automate legal marketing.