SIEMENS

Siemens Flatpanel-Display Technology

A&D IB SFT

TFT COLOR LCD MODULE

Type No. G23916-B65-H013-*

I-SFT 50i.2

I-SFT ™ Rev. II

10,5“ 640 x 480

SPECIFICATIONS

Internal Revision 0.2

02.01.2001

SIEMENS

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1 DESCRIPTION

I-SFT 50i.2 (G23916-B65-H013-*) is a TFT(thin film transistor) active matrix color liquid crystal display (LCD) comprising amorphous silicon TFT attached to each signal electrode, a driving circuit.
I-SFT 50i.2 (G23916-B65-H013-*) is a Siemens specific product consisting out of a Siemens specific third party manufactured LCD-Glass-Matrix with backlight (which is NOT available in retail), a specific backlight to drive the panel to surface 500 nit and an integrated inverter.
The 26cm diagonal display area contains 640×480 pixels and can display 262,144 colors simultaneously.

2 FEATURES

Backlight for 500 nit display surface
Thin and light weight
High contrast ratio, wide viewing angle, wide color gamut
Variable γ control
Wide temperature range
Accepting high shock and vibration levels
Data enable function
Fixable connector
Minimized image sticking (ghost pictures)
Integrated inverter for driving backlight
Colorspectrum adjusted to sunlight

3 APPLICATIONS

Industrial application

4 STRUCTURE AND FUNCTIONS

A TFT color LCD module comprises a TFT LCD panel, LSIs for driving liquid crystal. The TFT LCD panel is composed of a TFT array glass substrate superimposed on a color filter glass substrate with liquid crystal filled in the narrow gap between two substrates.

RGB (Red, Green, Blue) data signals are sent to LCD panel drivers after modulation into suitable forms for active matrix addressing through signal processor.

Each of the liquid crystal cells acts as an electro-optical switch that controls the incident light transmission by a signal applied to a signal electrode through the TFT switch.

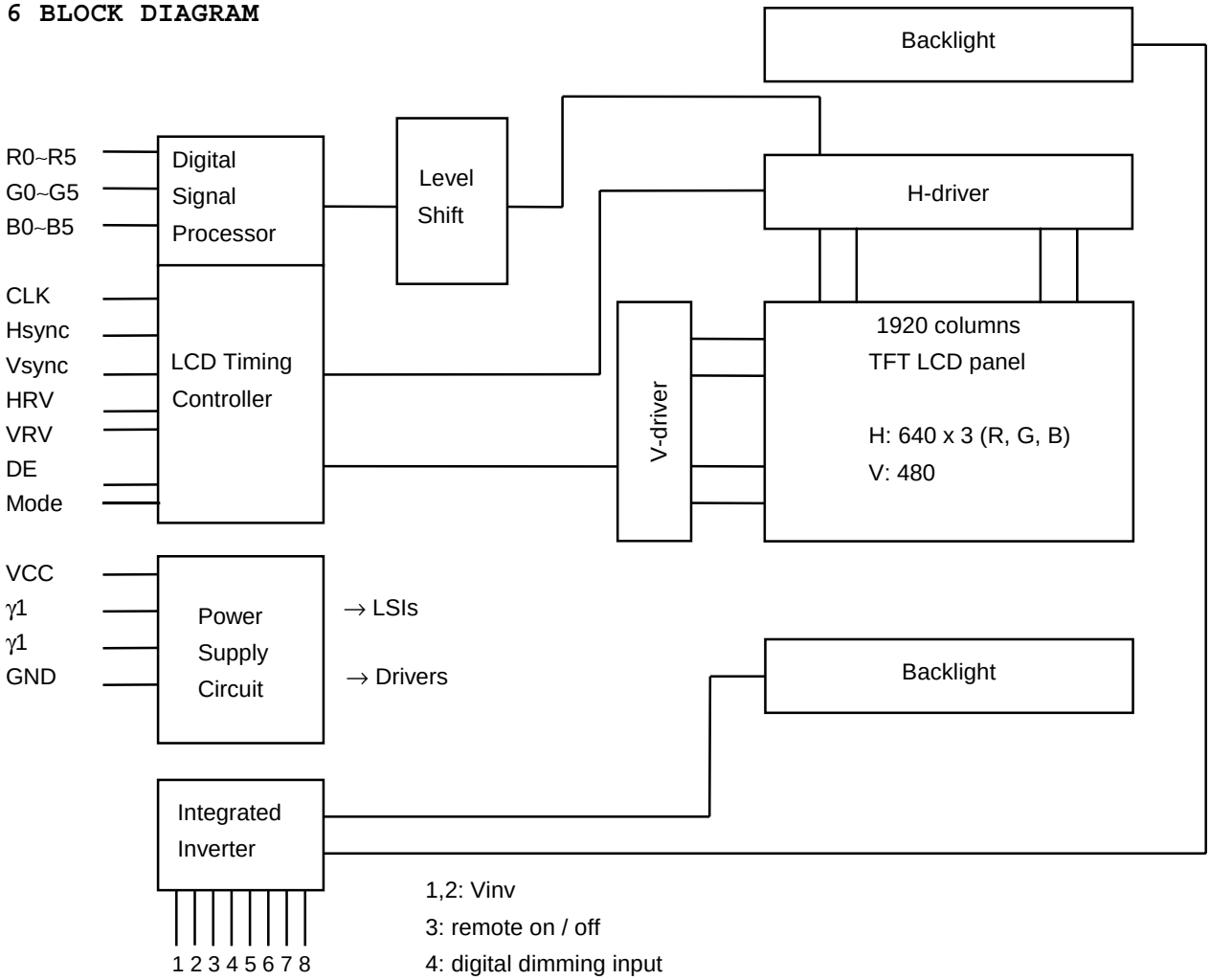
5 OUTLINE OF CHARACTERISTICS

Display area	211.7 mm(H) × 158.9 mm(V)
Drive system	a-Si TFT active matrix
Display colors	262,144 colors
Number of pixels	640 × 480
Pixel arrangement	RGB, vertical stripe
Pixel pitch	0.33 mm(H) × 0.33 mm(V)
Module size	194 mm(H) × 271 mm(V) × 28 mm(D)
Weight	1220 g (typ.)
Luminance	500 cd/m^2 (typ.)
Dimming range	1:250
Contrast ratio	250:1 (typ.) *note
Color gamut	50% (typ. at center, to NTSC) *note
Response time	15 ms (typ.), "white" to "black"
Transmittance	tbd
Incident light intensity	300,000 lux (max.) at the color filter side 20,000 lux (max.) at the TFT side
Signal system	6-bit digital signals for each of RGB primary colors, synchronous signals (hsync, vsync), Dot clock (CLK)
Supply voltage	5.0 V or 3.3 V (Logic, LCD driving), 12 VDC for integrated Inverter
Scanning direction	Vertical scanning is normal/reverse Horizontal scanning is normal/reverse

*note : Measuring light conditions

Lamp:	Cold Cathode Fluorescent Lamp
Chromaticity coordinates:	(x = 0.320; y = 0.325) typ.
Luminance at backlight surface:	1500 cd/m²

6 BLOCK DIAGRAM



1,2: Vinv
3: remote on / off
4: digital dimming input
5: reference voltage output
6: analog dimming input
7,8: GND

7 SPECIFICATIONS

7-1 GENERAL SPECIFICATIONS

Item	Specifications	Unit
Module size	194 (H) × 271 (V) × 28 (D)	mm
Display area	211.7 (H) × 158.9 (V)	mm
Number of pixels	640×3 (H) × 480 (V)	pixel
Dot pitch	0.11 (H) × 0.33 (V)	mm
Pixel pitch	0.33 (H) × 0.33 (V)	mm
Pixel arrangement	RGB (Red, Green, Blue) vertical stripe	-
Display colors	262,144	color
Weight	1220 (typ.)	g

7-2 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit	Remarks	
Supply voltage inverter	Vinv	typ. 12 VDC (min 9 VDC max. 15 VDC) *3	V	Ta = 25°C	
Supply voltage	Vcc	-0.3 to 6.5	V	Ta = 25°C	
Input voltage	VI	-0.3 to 6.5	V	VI – Vcc < 3.0	
Storage temp.	Tst	-35 to 85	°C		
Operation temp.	Top	-25 to 85 *1	°C		
Humidity	RH	≤ 95% relative humidity *2		Ta ≤ 40°C	no condensation
		≤ 85% relative humidity *2		Ta ≤ 50°C	
		Absolute humidity shall not exceed Ta=50C°, 85% relative humidity level *2		Ta > 50°C	
Incident light intensity	II	≤ 300k	lux	at backlight side	
		≤ 20k		at TFT side	

*1: measured at center display area (Front side)

*2: without any protection

*3: specified values for inverter valid for fixed input of 12 VDC only

7-3 ELECTRICAL CHARACTERISTICS

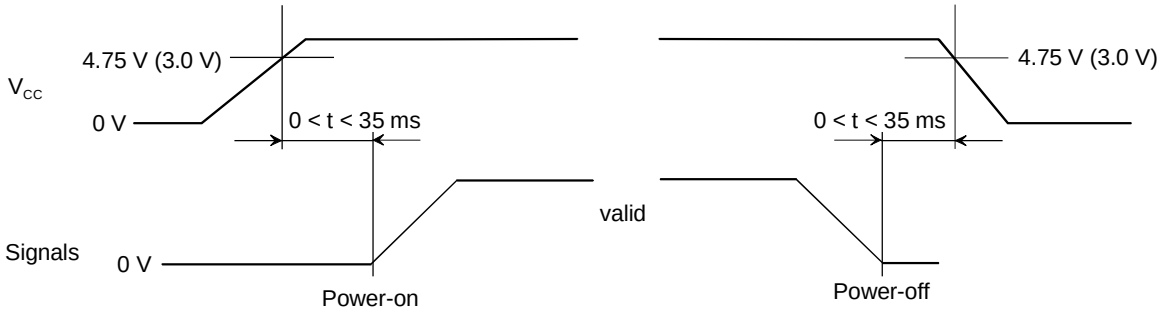
(1) Logic, LCD driving Ta = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply voltage	Vcc	4.75 (3.0)	5.0 (3.3)	5.25 (3.6)	V	Vcc = 5.0 V (Vcc = 3.3 V)
Logic input "L" voltage	VIL	0	-	VCC×0.3	V	CMOS level
Logic input "H" voltage	VIH	VCC×0.7	-	5.25	V	
Supply current	Icc	- -	400 ‡1 (500)	500 600	mA	Vcc = 5.0 V (Vcc = 3.3 V)
Input current (Low) ‡2	I0L1	-	10^{-5} (10^{-5})	10.0 (8.0)	µA	Vcc = 5.0 V (Vcc = 3.3 V)
VI = 0V	I0L2	-	-0.15 (-0.2)	-0.3 (-0.4)	µA	Vcc = 5.0 V (Vcc = 3.3 V)
Input current (High) ‡2	I0H1	-	10^{-5} (10^{-5})	10.0 (8.0)	µA	Vcc = 5.0 V (Vcc = 3.3 V)
VI = VCC	I0H2	-	100 (70)	200 (150)	µA	Vcc = 5.0 V (Vcc = 3.3 V)

‡1: Checker flag pattern (in EIAJ ED-2522)

‡2: I0L1, I0H1 ..... CLK, Hsync, Vsync, R0-R5, G0-G5, B0-B5, DE, MODE
I0L2, I0H2 ..... HRV, VRV

7-4 SUPPLY VOLTAGE SEQUENCE



note 1: The supply voltage for input signals should be the same as V_{CC}.

note 2: Turn on the backlight within the LCD operation period. When the backlight turns on before LCD operation or the LCD operation turns off before the backlight turns off, the display becomes momentarily white.

note 3: When the power is off, please keep whole signals (Hsync, Vsync, CLK, DE, MODE and DATA) low level or high impedance.

7-5 INTERFACE PIN CONNECTION

(1) Interface signals, power supply

Module side connector
CN1 : PS-34PE-D4LT1-SM1 (JAE)

Mating connector
PS-34SM-D4P1-1C

Pin NO.	Symbol	Function	Pin NO.	Symbol	Function
1	GND	Ground	18	G5	Green data (MSB)
2	CLK	Dot clock	19	GND	Ground
3	Hsync	Horizontal sync	20	B0	Blue data (LSB)
4	Vsync	Vertical sync	21	B1	Blue data
5	GND	Ground	22	B2	Blue data
6	R0	Red data (LSB)	23	B3	Blue data
7	R1	Red data	24	B4	Blue data
8	R2	Red data	25	B5	Blue data (MSB)
9	R3	Red data	26	GND	Ground
10	R4	Red data	27	DE	Data enable
11	R5	Red data (MSB)	28	Vcc	Power supply
12	GND	Ground	29	Vcc	Power supply
13	G0	Green data (LSB)	30	MODE	note 1
14	G1	Green data	31	HRV	note 2
15	G2	Green data	32	VRV	note 3
16	G3	Green data	33	γ1	note 4
17	G4	Green data	34	γ2	note 4

note

1) MODE : L or OPEN = DE mode
H = fixed timing mode

2) HRV *: L or OPEN = scanning is normal
H = scanning is reverse
47 KΩ at pull down (old 1 KΩ)

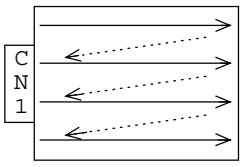
3) VRV *: L or OPEN = scanning is normal
H = scanning is reverse
47 KΩ at pull down (old 1 KΩ)
*see from TFT side.

LSB: Least Significant Bit
MSB: Most Significant Bit

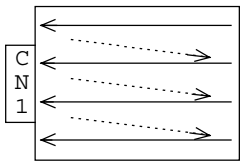
Input current

Vin = 0 V	-0,15µ	Vcc 5.0 V
	-0,2µ	Vcc 3.3 V
Vin = Vcc	100µ	Vcc 5.0 V
	70µ	Vcc 3.3 V

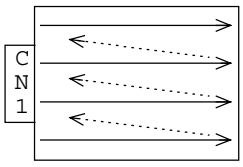
HRV : L, VRV : L



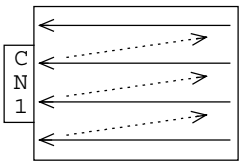
HRV : H, VRV : L



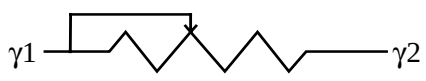
HRV : L, VRV : H



HRV : H, VRV : H



4) γ1,γ2: Adjustment of γ correction. The pins 33 "γ1" and 34 "γ2" should be left open for best optical performance! (otherwise the optical performance will be programmed for special use).



Variable resistor for
special use ONLY!
Mating VR: 2.2 kΩ ± 5%

5) GND is connected to frame of the LCD module.

7-6 DISPLAY COLORS vs. INPUT DATA SIGNALS

Display colors		Data signal(0: Low level, 1: High level)																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	dark	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	↑																		
	↓																		
	bright	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	dark	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	↑																		
	↓																		
	bright	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
		0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	↑																		
	↓																		
	bright	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

note: colors are developed in combination with 6 bit signals (64 steps in grayscale) of each primary red, green, and blue color.
This process can result in up to 262,144 (64×64×64) colors.

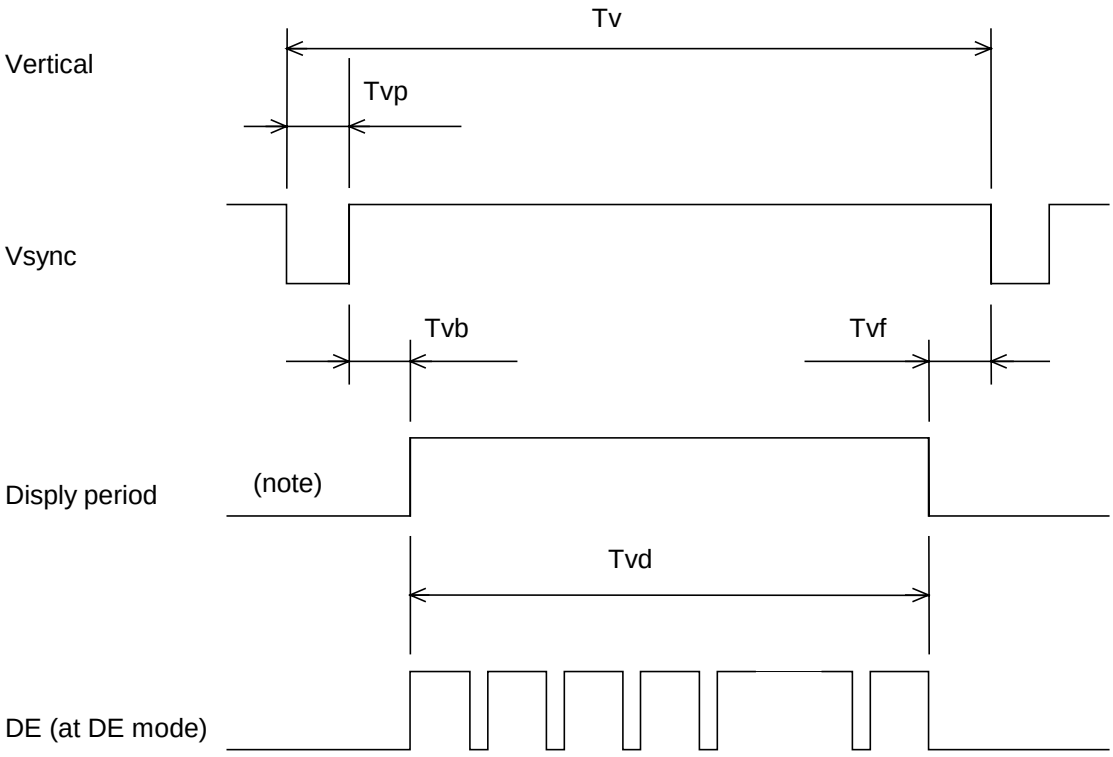
7-7 INPUT SIGNAL TIMING

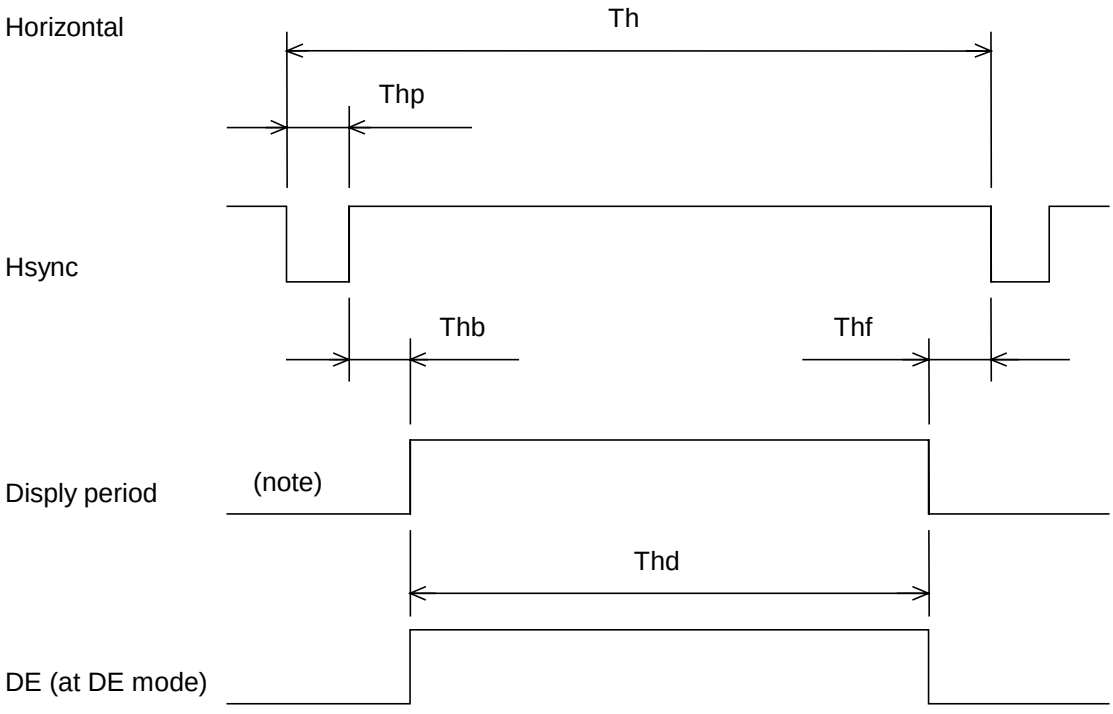
(1) INPUT SIGNAL SPECIFICATION

Parameter		Symbol	MIN.	TYP.	MAX.	Unit	Remarks
CLK	Frequency	1/Tc	21.0	25.175	29.0	MHz	39.722ns(TYP.)
	Duty	Tch/Tc	0.4	0.5	0.6		
	Rise, Fall	Tcrf	-	-	10	ns	
Hsync	Period	Th	30.0	31.778	33.6	µs	31.469kHz(TYP.)
			-	800	-	CLK	
	Display period	Thd		640		CLK	
	Front-porch	Thf	-	16	-	CLK	fixed timing mode
			4	16	-	CLK	DE mode
	Pulse width	Thp *)	10	96	140	CLK	fixed timing mode
			10	96	-	CLK	DE mode
	Back-porch	Thb *)	4	48	134	CLK	fixed timing mode
			4	48	-	CLK	DE mode
	*) Thp+Thb			144		CLK	fixed timing mode
			14	144	-	CLK	DE mode
	CLK-Hsync timing	Thch	12	-	-	ns	
	Hsync-CLK timing	Thcs	8	-	-	ns	
	Hsync-Vsync timing	Tvh	1	-	-	CLK	1CLK=39.722ns(Typ)
	Vsync-Hsync timing	Tvs	30	-	-	ns	
	Rise, Fall	Thrf	-	-	10	ns	
Vsync	Period	Tv	16.1	16.683	17.2	ms	59.94Hz(TYP.)
			-	525	-	H	
	Display period	Tvd		480		H	
	Front-porch	Tvf	-	12	-	H	fixed timing mode
			1	12	-	H	DE mode
	Pulse width	Tvp *)	1	2	29	H	fixed timing mode
			1	2	-	H	DE mode
	Back-porch	Tvb *)	4	31	32	H	fixed timing mode
			4	31	-	H	DE mode
	*) Tvp+Tvb			33		H	fixed timing mode
			5	33	-	H	DE mode
	Rise, Fall	Tvrf	-	-	10	ns	
DATA R0-R5 G0-G5 B0-B5	CLK-DATA timing	Tds	8	-	-	ns	
	DATA-CLK timing	Tdh	12	-	-	ns	
	Rise, Fall	Tdrf	-	-	10	ns	
DE	DE-CLK timing	Tes	8	-	-	ns	DE mode
	CLK-DE timing	Teh	12	-	-	ns	
	Rise, Fall	Terf	-	-	10	ns	

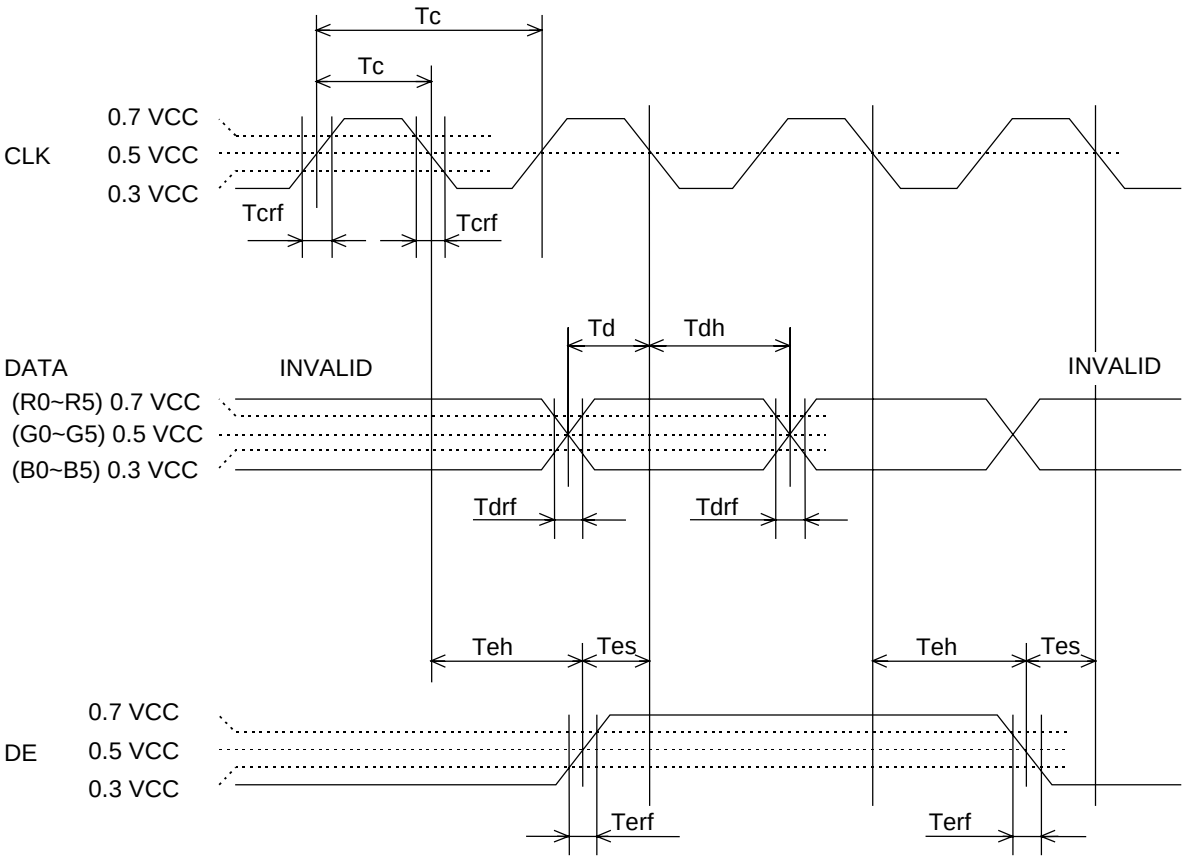
note: All parameters should be kept within the specified range.

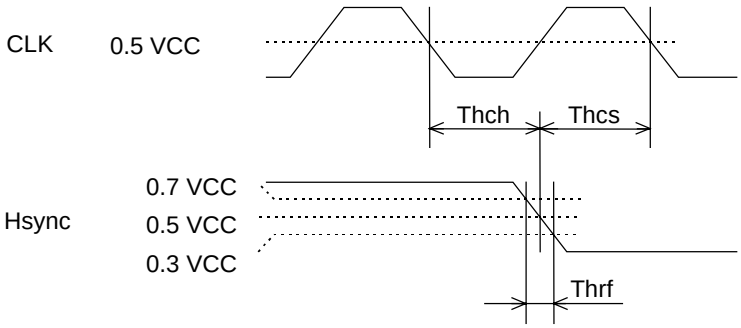
(2) DEFINITION OF INPUT SIGNAL TIMING

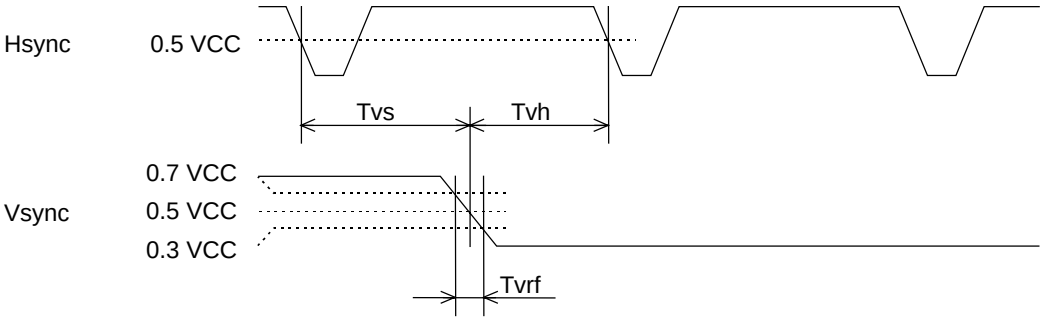




note: these signals do not exist

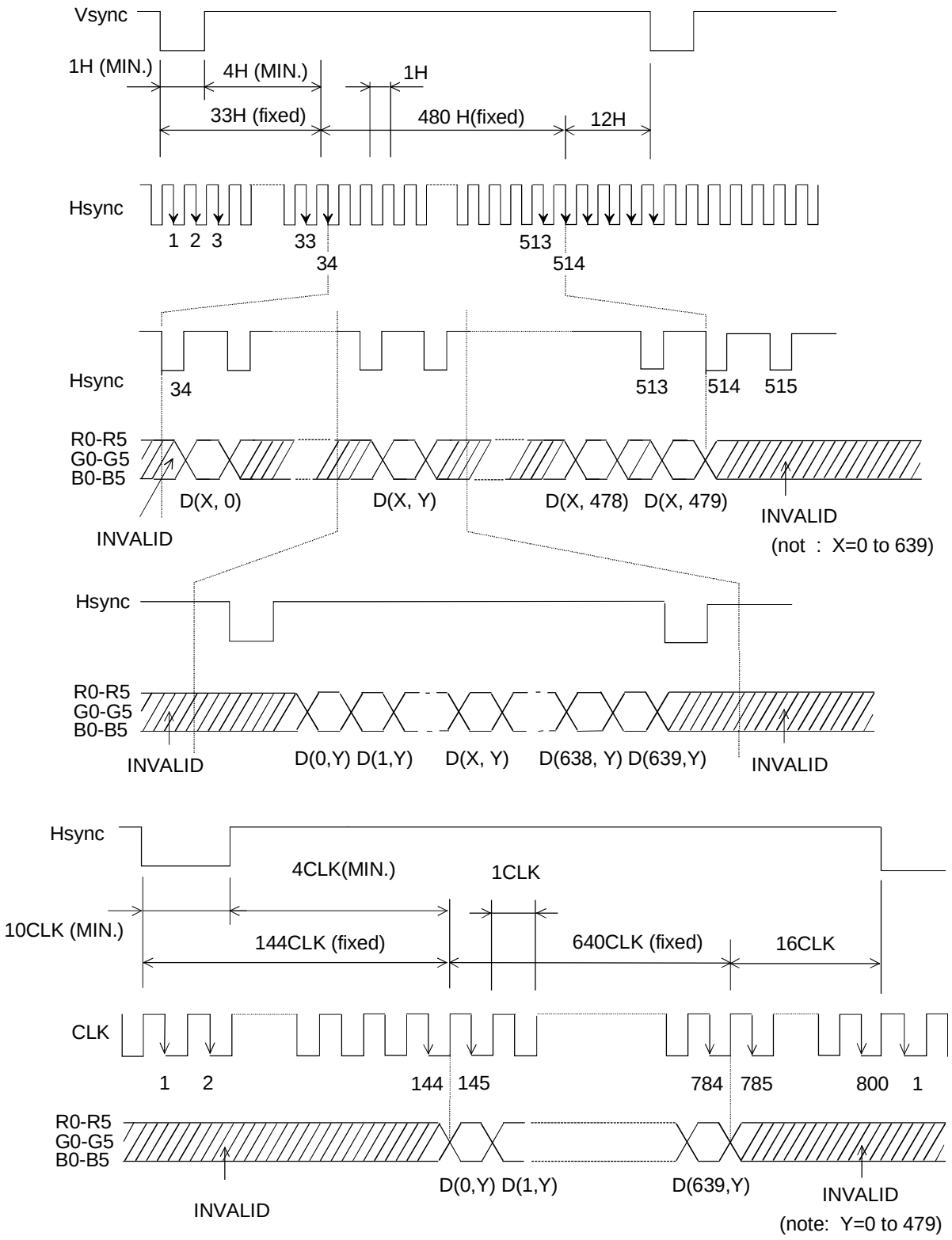

Tc
Tc
CLK
0.7 VCC
0.5 VCC
0.3 VCC
Tcrf
Tcrf
Td
Tdh
DATA
INVALID
INVALID
(R0~R5) 0.7 VCC
(G0~G5) 0.5 VCC
(B0~B5) 0.3 VCC
Tdrf
Tdrf
Teh
Tes
Teh
Tes
DE
0.7 VCC
0.5 VCC
0.3 VCC
Terf
Terf


CLK
0.5 VCC
Thch
Thcs
Hsync
0.7 VCC
0.5 VCC
0.3 VCC
Thrf

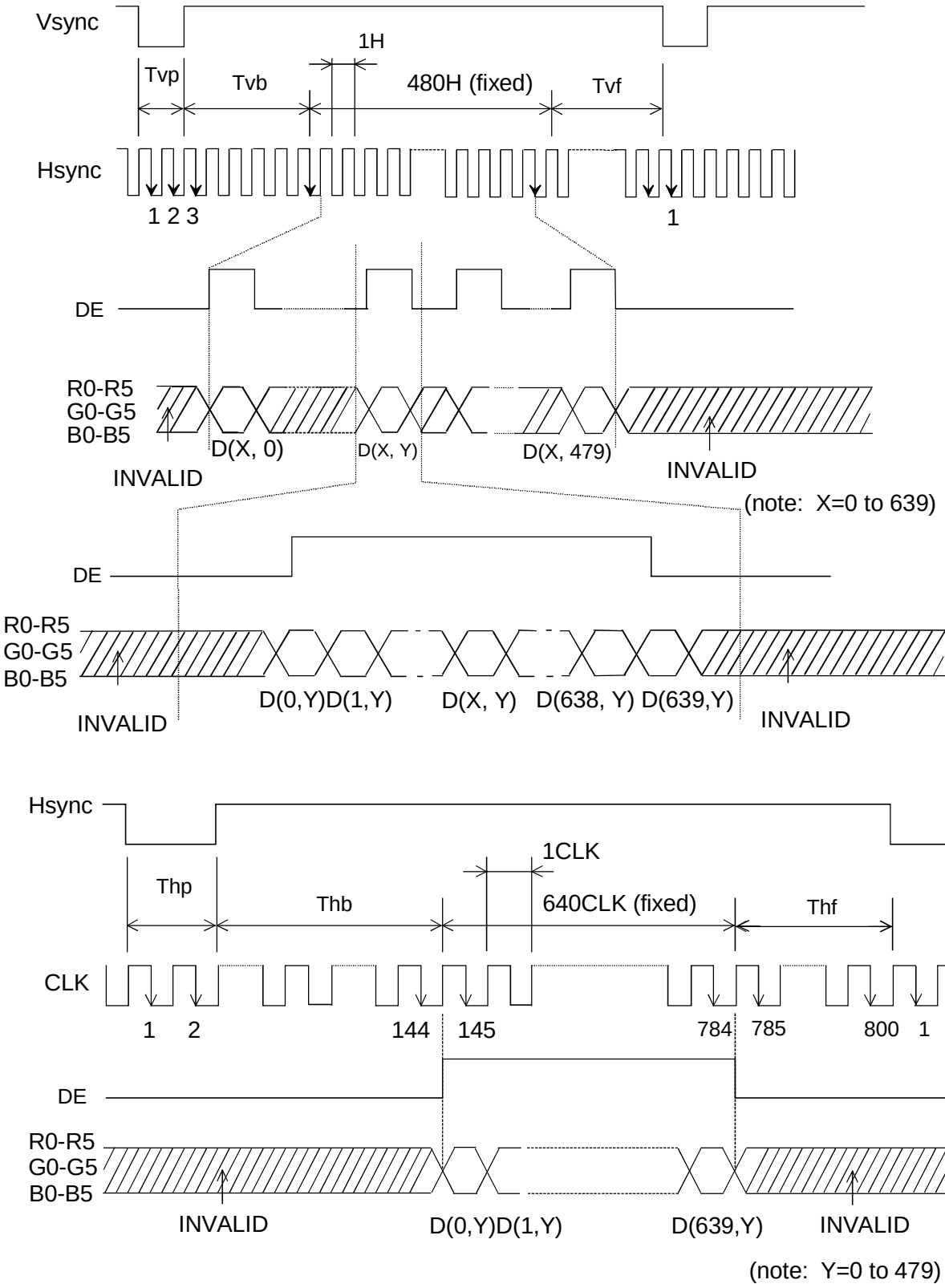

Hsync
0.5 VCC
Tvs
Tvh
Vsync
0.7 VCC
0.5 VCC
0.3 VCC
Tvrf

(3) INPUT SIGNAL TIMING CHART

a) fixed timing mode



b) DE mode


Vsync
1H
Tvp
Tvb
480H (fixed)
Tvf
Hsync
1 2 3
1
DE
R0-R5
G0-G5
B0-B5
D(X, 0)
D(X, Y)
D(X, 479)
INVALID
INVALID
(note: X=0 to 639)
DE
R0-R5
G0-G5
B0-B5
INVALID
D(0,Y)D(1,Y)
D(X, Y)
D(638, Y)
D(639,Y)
INVALID
Hsync
1CLK
Thp
Thb
640CLK (fixed)
Thf
CLK
1
2
144
145
784
785
800
1
DE
R0-R5
G0-G5
B0-B5
INVALID
D(0,Y)D(1,Y)
D(639,Y)
INVALID
(note: Y=0 to 479)

7-8 DISPLAY POSITION at HRV: L and VRV: L

D(0,0)	D(1,0)	———	D(X,0)	———	D(638,0)	D(639,0)
D(0,1)	D(1,1)	———	D(X,1)	———	D(638,1)	D(639,1)
D(0,Y)	D(1,Y)	———	D(X,Y)	———	D(638,Y)	D(639,Y)
D(0,478)	D(1,478)	———	D(X,478)	———	D(638,478)	D(639,478)
D(0,479)	D(1,479)	———	D(X,479)	———	D(638,479)	D(639,479)

7-9 DEFECT SPECIFICATIONS

a) Inspection conditions

Distance : the distance between the inspector's eye and the LCD panel is 20cm.

Illumination : the distance between a 20-W fluorescent lamp and the LCD panel is 25-30 cm.

Temperature : Room temperature is 25C°±5C°.

Viewing angle:

Display specifications : $-20° \leq \theta x \leq +20°$, $0° \leq \varnothing y \leq +20°$

Appearance specifications: $-45° \leq \theta x \leq +45°$, $-45° \leq \varnothing y \leq +45°$

Measuring light conditions: Lamp: Cold Cathode Fluorescent Lamp

Chromaticity coordinates (x = 0.320, y = 0325) typ.

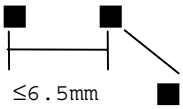
Luminance of backlight surface for inspection: 1500 cd/m²

b) Display specifications

Item	Specifications			
Line defect	Not allowed			
Luminous dots *1	Color	Brightness	Distance between same color dots	Quantity
	Red, Green	F + H	-	R + G ≤ 6
		F	-	R ≤ 6 , G ≤ 3
	Blue	F + H	-	≤ 6
		F	-	≤ 6
	Red, Green, Blue	F	≤ 6.5 mm *4	R, G, B ≤ 0
			Linked two or more dots *3	R, G, B ≤ 0
Dark dots *2	Color	Distance between dark dots		Quantity
	Black	-		R + G + B ≤ 16 R, G, B ≤ 7
		Linked two dots *3		≤ 1 pair
		Linked three or more dots *3		≤ 0
		≤ 6.5 mm *4		≤ 0

*1 F: Full luminous dots (Bright point independent of viewing angle)
H: Half luminous dots (Bright point dependent on viewing angle)
Luminous dots are measured while the screen is black.
*2 Dark dots are measured while the screen is illuminated with Red, Green, or Blue.
*3 Linkage means linked two or more dots.
(■ Luminous or Dark dot)

*4 ≤ 6.5 mm is considered with:
(■ :Luminous or Dark dot)



	To be counted	To be uncounted
Luminous dots	Same color	Different color
Dark dots	Same screen	Different screen

*5 The dot-amounts of linkage and <6.5 mm are counted when the dots are only full luminous.

c) Appearance specifications

Item	Specifications		
	Measurement criteria		Quantity
Other objects Stains Dust (dot shape)	Average diameter(∅) mm		Allowed value
	∅ ≤0.2		all allowed
	0.2< ∅ <0.3		≤10 points
	0.3< ∅ ≤0.5		≤ 3 points
	0.5< ∅ Linked other objects		0 point
Other objects Stains Dust (line shape)	Width(W) mm	Length(L) mm	
	W ≤ 0.05	-	all allowed
	0.05 ≤ W ≤ 0.1	L < 0.7	
		0.7 ≤ L ≤ 1.0	≤ 4 points
		1.0 < L	0 point
	0.1 < W	-	
Polarizer Bubbles	Average diameter(∅) mm		
Wrinkles Dent	∅ ≤ 0.5		< 2 points
Panel dent	∅ ≤ 0.5		< 2 points
Polarizer scratch	Remarkable scratches		0 point
Form	Specified labels and parts are put		

The relevant data for the values above a only valid under conditions described at 7-9 "a".

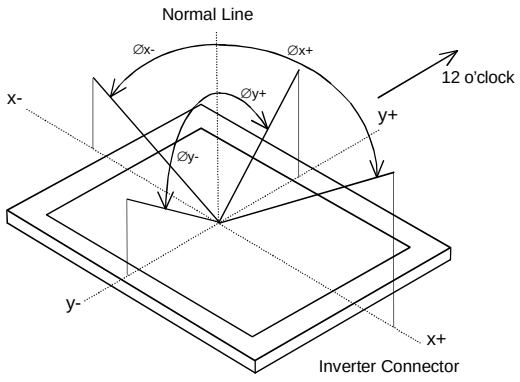
7-10 OPTICAL CHARACTERISTICS

Ta = 25°C ± 5°C note 1

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	Øx+	CR>5, Øy = ±0°	-	80	-	deg.	
		Øx-	CR>5, Øy = ±0°	-	80	-	deg.	note 2
	Vertical	Øy+	CR>5, Øx = ±0°	-	45	-	deg.	
		Øy-	CR>5, Øx = ±0°	-	80	-	deg.	
Contrast ratio		CR	Øy=-5°, Øx=±0°	-	250	-	-	note 3
Response time		tpd	white to black black to white	- -	15 35	- -	ms	note 4
Luminance (center of screen)		Lw	at center		500		cd/m^2	note 6
Dimming range		DR			1:250			
Color gamut		C	at center, to NTSC	40	50	-	%	note 5
Chromaticity	Red	Rx Ry	at center	- -	0,594 0,372	- -	- -	
	Green	Gx Gy	„	- -	0,343 0,560	- -	- -	note 5
	Blue	Bx By	„	- -	0,171 0,191	- -	- -	
	White	Wx Wy	„	- -	0,361 0,386	- -	- -	
γ correction		γ	γ1-γ2 :0 Ω γ1-γ2 :2 kΩ	- -	tbd tbd	- -	-	

note 1: Vcc = 5.0 V

note 2: Definitions of viewing angle are as follows. (matrix facing up, connector on the right side)

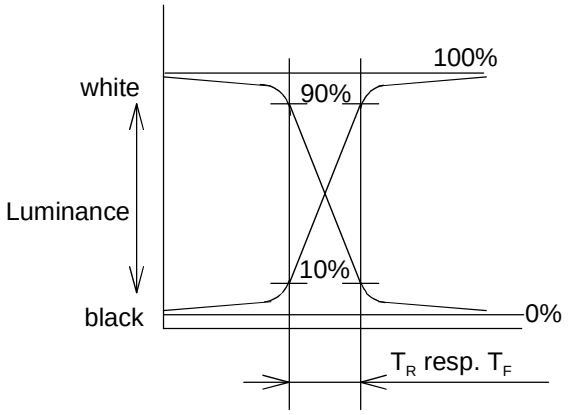


note 3: The contrast ratio is calculated by using the following formula:

$$\text{Contrast ratio} = \frac{\text{Brightness (Luminance) with all pixels in “White”}}{\text{Brightness (Luminance) with all pixels in “Black”}}$$

the brightness is measured in darkroom.

note 4: Definition of response time is as follows.
Photodetector output signal is measured when the brightness changes "white" to "black". Response time is the time between 10% and 90% of the photodetector output amplitude.

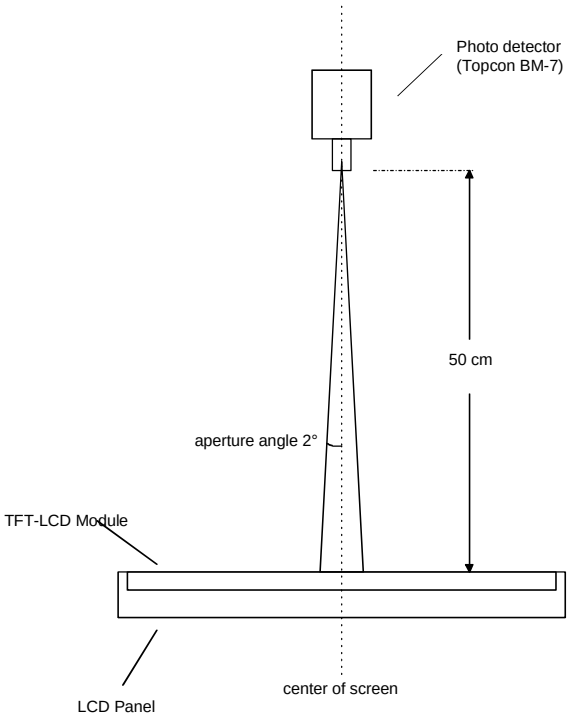


Reference data

Ta = 0°C	white to black	tpd = 15 ms typ.
	black to white	tpd = 35 ms typ.

note 5: For the measurement of color gamut and chromaticity, transmittance, use a lamp with a color temperature of 6000 K and a luminance of 1500 cd/m^2.
The chromaticity value is: x = 0.320, y = 0.325.

note 6: Brightness measurements setup
The measurement should be executed in a dark room 30 min. after lightning the backlight. Matrix: off state. The brightness is measured in the center of the screen.
Environment condition: T = 25 ± 2 °C, it has to be assured that a sufficient heat flow / air circulation is given



7-11 INVERTER SPECIFICATIONS

a) PIN CONNECTION

Connector (Series): JST S8B-PH-SM3-TBc

corresponding connector: housing JST PHR-8, contacts JST SPH-002T-P0.5S

Pin #	Description	value
1	Supply voltage for Inverter	typ. 12 VDC / 1,6 A *1
2	Supply voltage for Inverter	typ. 12 VDC / 1,6 A *1
3	Remote on / off	n.c. -> On *2; GND -> Off
4	Digital dimming input	PWM, TTL - Level
5	Reference voltage output For dimming with variable resistor	5 V 4K7
6	Analog dimming input	0–5 VDC *3
7	Ground	GND *1
8	Ground	GND *1

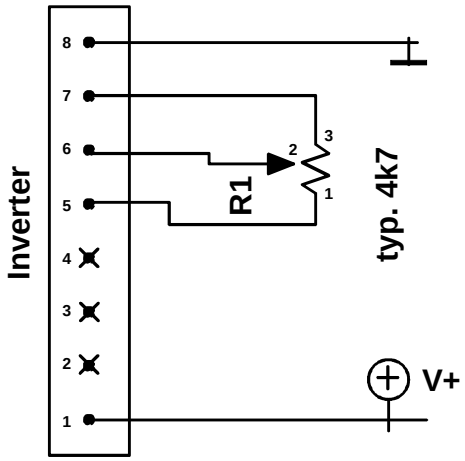
Attention: depending on source and temperature, when switching on, the inverter current can be much higher (see separate application note)

*1 for connection use both pin 1 and 2 parallel and pin 7 and 8 parallel

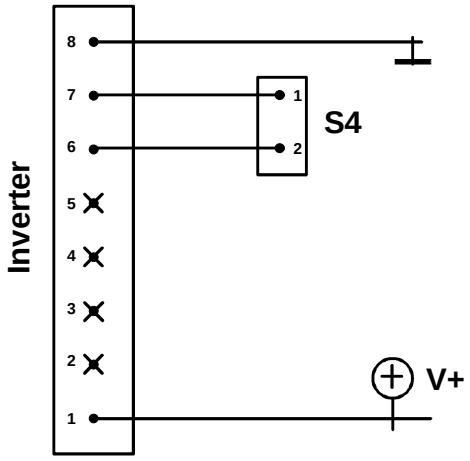
*2 n.c.: no connection (leave pin open)

*3 If no dimming is required, you have to short pin 6 and pin 5 for maximum brightness, 0 VDC= dark, 5 VDC= bright

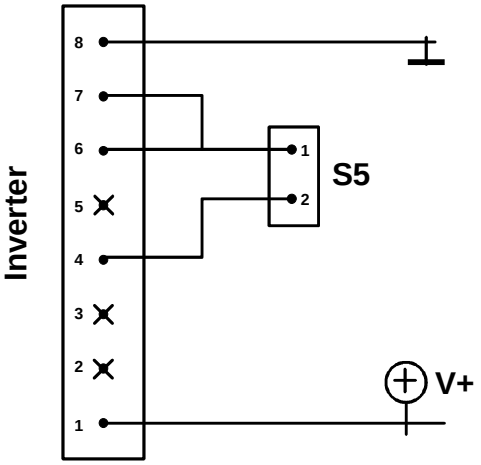
b) INVERTER CONNECTIONS



1) Dimming with variable Resistor (pin 7: 0 V)



2) Dimming with variable analog DC voltage. Variable voltage 0 to 5 VDC (pin 7: 0 V)



3) Digital Dimming with PWM control 0 to 100% PWM, PWM 200-1000 Hz; TTL-Level (pin 7: 0 V)

7-12 RELIABILITY TEST 1

No.	Test Item	number	Test Condition	Judgement
1.	High Temperature (operation)	10p	1. 85 ±2°C 2. 120 hours 2. Display data is black. *4	*1
2.	High Temperature /Humidity (operation)	10p	1. 60 ±2°C, 90% relative humidity 2. 24 hours 3. Display data is black. *4	*1
3.	Thermal shock (operation)	10p	1. -35 ±3°C,...30minutes 85 ±3°C,...30minutes 2. 100cycles 3. Temperature change within 5 minutes	*1
4.	Heat Cycle (operation)	10p	1. -25 ±3°C...2hours 85 ±3°C...2hours 2. 35 cycles 3. Temperature change within 2 hours 4. Display data is black. *4	*1
5.	Vibration (operation)	5p	1. 5-8. 4 Hz....21 mmp-p 8. 4-15O Hz..3G 1 minute/cycle, X,Y,Z 6 direction sinewave, Log sweep, 25 ±5°C 2. 20 times each direction Display data is black. *4	*1
6.	Mechanical Shock (operation)	5p	1. 100 G, 11 ms X,Y,Z direction Half sinwave, 25 ±5°C 2. 5 times each direction 3. Display data is black. *4	*1 *2
7.	ESD (non-operation)	5p	150 PF, 150 Ω, +10 kV 9 places on a panel *3 10 times each place at 1sec intervals.	*1
8.	Drop Test (non-operation)	1 box	Drop packaged modules to concrete floor from 70 cm high, 3 times each face.	*1

*1: Display function

*2: Physical damage.

*3: Discharge points are shown in the figure.

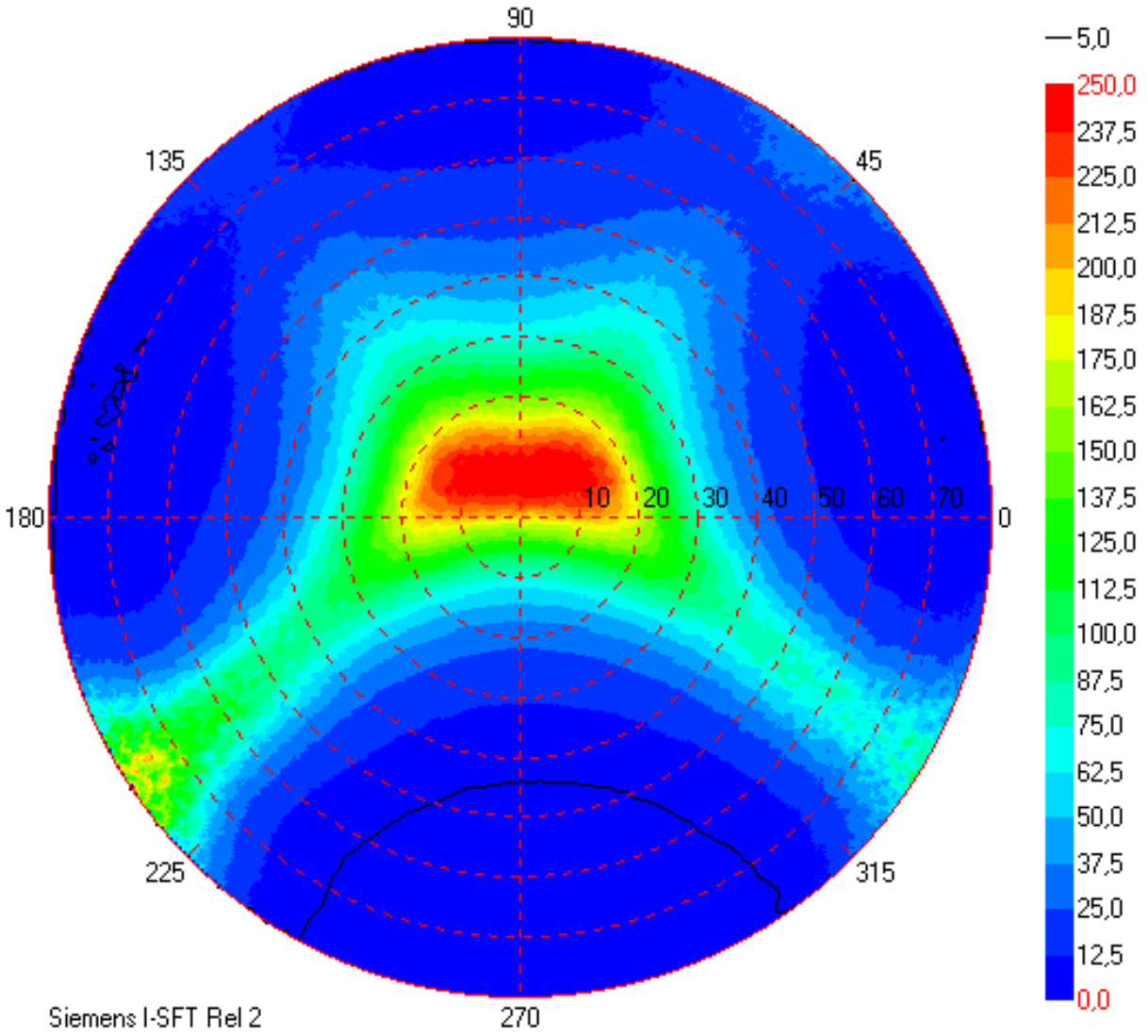
*4: all pixel are "ON"

1	2	3
4	5	6
7	8	9

Reliability tests for design check

			under calculation	

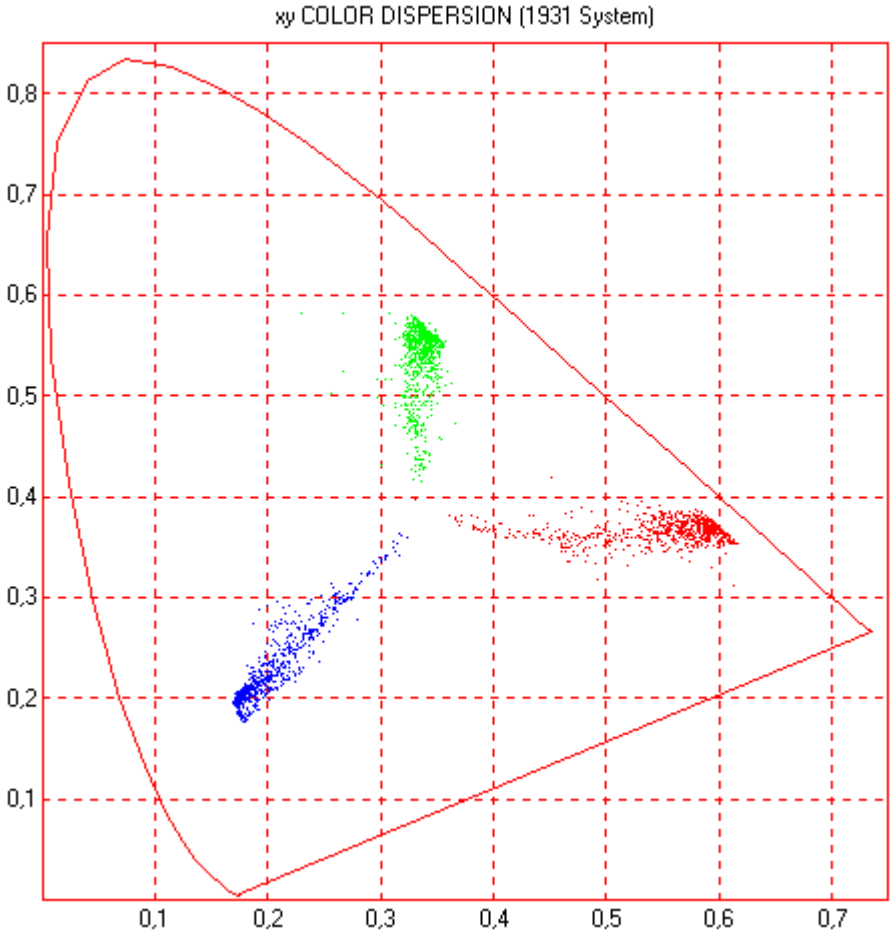
7.13 MEASUREMENTS



Typical measurement for Siemens I-SFT Rel 2
(Display orientation: connector points to the left)

This omni-directional plot shows contrast ratio vs. viewing angle
in range of left/right 80°/ 80°
and top/down 80° / 80°.

The different colors represent the contrast from 0 contrast (dark blue)
to 250:1 contrast (bright red)



This plot shows the distribution of color coordinates for red, green and blue over the complete viewing angle of left / right 80° / 80° and top / down 80° / 80°.