

SPEC for Mass Production

Spec No.	TQ3C-8EAF0-E1YAM44-00
Date	November 13, 2019

TYPE : TCG121WXLRFVNN-AN70

< 12.1 inch WXGA transmissive color TFT with LED backlight
and constant current circuit for LED backlight >

CONTENTS

1. Application
2. Construction and outline
3. Mechanical specifications
4. Absolute maximum ratings
5. Electrical characteristics
6. Optical characteristics
7. Interface signals
8. Input timing characteristics
9. Lot number identification
10. Warranty
11. Precautions for use
12. Reliability test data
13. Outline drawing



KYOCERA CORPORATION

This specification is subject to change without notice.
Consult Kyocera before ordering.

Original Issue Date	Designed by: Engineering dept.			Confirmed by: QA dept.	
	Prepared	Checked	Approved	Checked	Approved
November 13, 2019	K. Eda	M. Doshiki	A. Imachi	S. Kishimoto	D. Sato

Spec No.	Part No.	Page
TQ3C-8EAF0-E1YAM44-00	TCG121WXLRFVNN-AN70	-

Warning

1. This Kyocera LCD module has been specifically designed for use only in electronic devices and industrial machines in the area of audio control, office automation, industrial control, home appliances, etc. The module should not be used in applications where the highest level of safety and reliability are required and module failure or malfunction of such module results in physical harm or loss of life, as well as enormous damage or loss. Such fields of applications include, without limitation, medical, aerospace, communications infrastructure, atomic energy control. Kyocera expressly disclaims any and all liability resulting in any way to the use of the module in such applications.
2. Customer agrees to indemnify, defend and hold Kyocera harmless from and against any and all actions, claims, damages, liabilities, awards, costs, and expenses, including legal expenses, resulting from or arising out of Customer's use, or sale for use, or Kyocera modules in applications.

Caution

1. Kyocera shall have the right, which Customer hereby acknowledges, to immediately scrap or destroy tooling for Kyocera modules for which no Purchase Orders have been received from the Customer in a two-year period.

Spec No. TQ3C-8EAF0-E1YAM44-00	Part No. TCG121WXLRFVNN-AN70	Page -
-----------------------------------	---------------------------------	-----------

Revision record

Date		Designed by : Engineering dept.			Confirmed by : QA dept.	
		Prepared	Checked	Approved	Checked	Approved
Rev.No.	Date	Page	Descriptions			

1. Application

This document defines the specification of TCG121WXLRFVNN-AN70. (RoHS Compliant)

2. Construction and outline

LCD	: Transmissive color dot matrix type TFT
Backlight system	: LED
Polarizer	: Anti-Glare treatment
Interface	: LVDS
Additional circuit	: Timing controller, Power supply (3.3V input) Constant current circuit for LED Backlight (12V input)

3. Mechanical specifications

Item	Specification	Unit
Outline dimensions 1)	283.0(W)×185.1(H)×10.5(D)	mm
Active area	261.12(W)×163.2(H) (30.8cm/12.1 inch(Diagonal))	mm
Dot format	1280×(R,G,B)(W)×800(H)	dot
Dot pitch	0.068(W)×0.204(H)	mm
Base color 2)	Normally Black	-
Mass	(600)	g

1) Projection not included. Please refer to outline for details.

2) Due to the characteristics of the LCD material, the color varies with environmental temperature.

4. Absolute maximum ratings

4-1. Electrical absolute maximum ratings

Item		Symbol	Min.	Max.	Unit
Supply voltage(+3.3V)		V_{DD}	(-0.3)	(4.0)	V
Supply voltage(+12V)		V_{DD}	(-0.3)	(14.0)	V
Input signal Voltage 1)	RxINi+, RxINi- (i=0,1,2,3)	V_{I1}	(-0.3)	(2.8)	V
	CK IN+, CK IN-	V_{I2}	(-0.3)	(2.8)	V
	MODE, SC	V_{I3}	(-0.3)	($V_{DD}+0.5$)	V
	BLBRT,BLEN	V_{I4}	(-0.3)	(V_{in})	V

1) V_{DD} must be supplied correctly within the range described in 5-1.

4-2. Environmental absolute maximum ratings

Item	Symbol	Min.	Max.	Unit
Operating temperature(Ambient) 1)	$T_{OP(Ambient)}$	(-30)	(80)	°C
Operating temperature(Panel) 2)	Top (Panel)	(-30)	(80)	°C
Storage temperature 3)	T_{STO}	(-30)	(80)	°C
Operating humidity 4)	H_{OP}	(10)	5)	%RH
Storage humidity 4)	H_{STO}	(10)	5)	%RH
Vibration	-	6)	6)	-
Shock	-	7)	7)	-

1) Operating temperature means a temperature which operation shall be guaranteed. Since display performance is evaluated at 25°C, another temperature range should be confirmed.

2) Panel / Backboard surface temperature (all the surface)

3) Temp. = -30°C < 48h , Temp. = 80°C < 168h

Store LCD at normal temperature/humidity. Keep them free from vibration and shock.

An LCD that is kept at a low or a high temperature for a long time can be defective due to other conditions, even if the low or high temperature satisfies the standard.

(Please refer to "Precautions for Use" for details.)

4) Non-condensing

5) Temp. ≤ 40°C, 85%RH Max.

Temp. > 40°C, Absolute humidity shall be less than 85%RH at 40°C.

6)

Frequency	10~55 Hz	Acceleration value (0.3~9 m/s ²)
Vibration width	0.15mm	
Interval	10-55-10 Hz	1 minutes

2 hours in each direction X, Y, Z (6 hours total)

EIAJ ED-2531

7) Acceleration: 490 m/s², Pulse width: 11 ms

3 times in each direction: ±X, ±Y, ±Z

EIAJ ED-2531

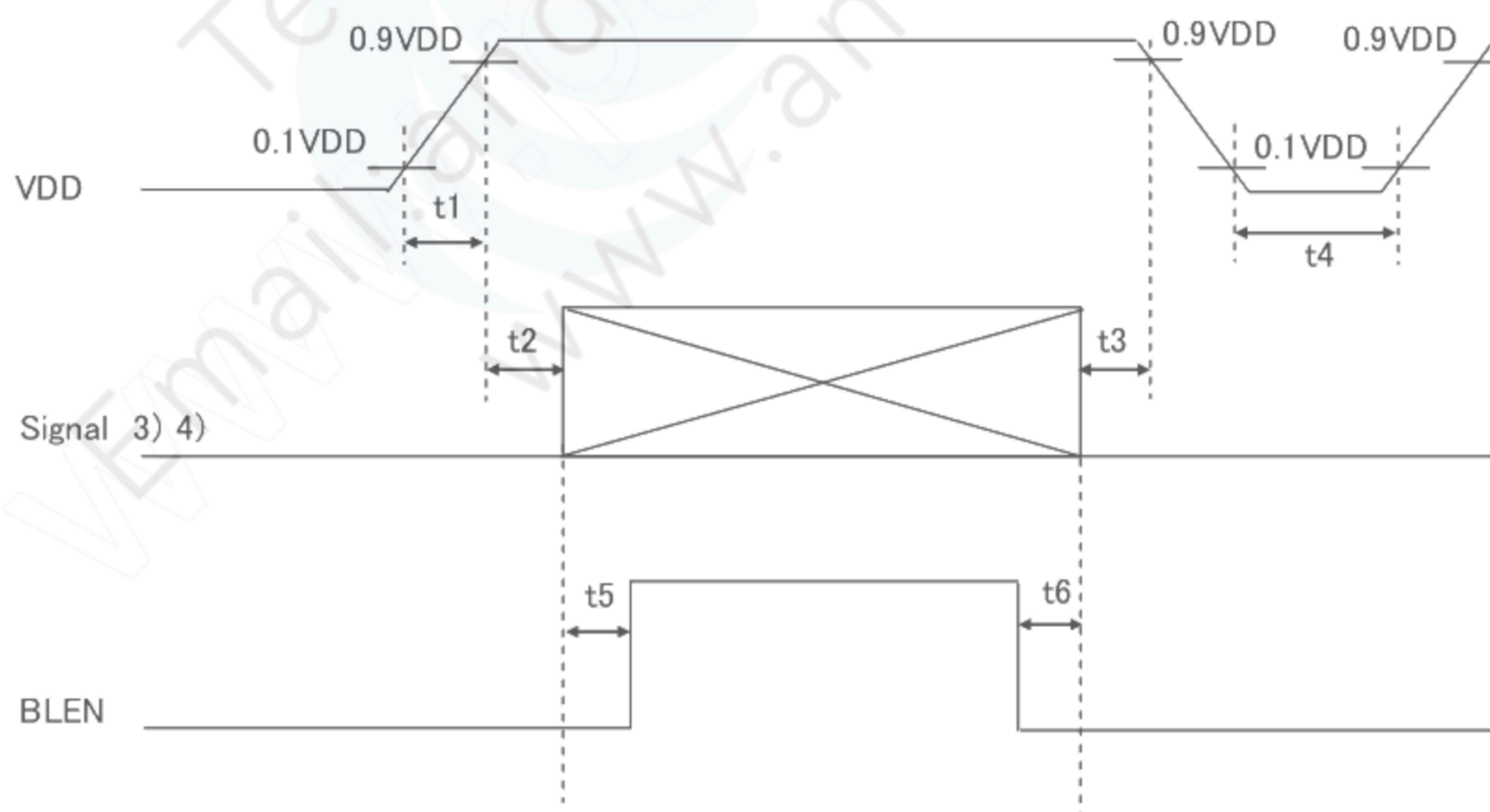
5. Electrical characteristics

5-1. LCD

Temp. = -30~80°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage 1)	V_{DD}	-	3.0	3.3	3.6	V
Current consumption	I_{DD}	2)	-	(410)	(500)	mA
Permissive input ripple voltage	V_{RP}	$V_{DD}=3.3V$	-	-	(100)	mVp-p
Input signal voltage 3)	V_{IL}	"Low" level	(0)	—	(0.8)	V
	V_{IH}	"High" level	(2.0)	—	(V_{DD})	V
Input leak current	I_{OL}	$V_{I3}=0V$	(-10)	-	(10)	μA
	I_{OH}	$V_{I3}=3.3V$	-	-	(400)	μA
LVDS Input voltage 4)	V_L	-	(0)	-	(1.9)	V
Differential input voltage 4)	V_{ID}	-	(100)	(350)	(600)	mV
Differential input threshold voltage 4) 5)	V_{TL}	"Low" level	($V_{CM}-100$)	—	—	mV
	V_{TH}	"High" level	—	—	($V_{CM}+100$)	mV
Terminator	R_1	-	-	(100)	-	Ω
V_{DD} -turn-on conditions 1)	t_1	-	(0.1)	-	(10)	ms
	t_2	-	(0)	-	-	ms
	t_3	-	(0)	-	-	ms
	t_4	-	(1.0)	-	-	s
	t_5	-	(200)	-	-	ms
	t_6	-	(200)	-	-	ms

1) V_{DD} -turn-on conditions

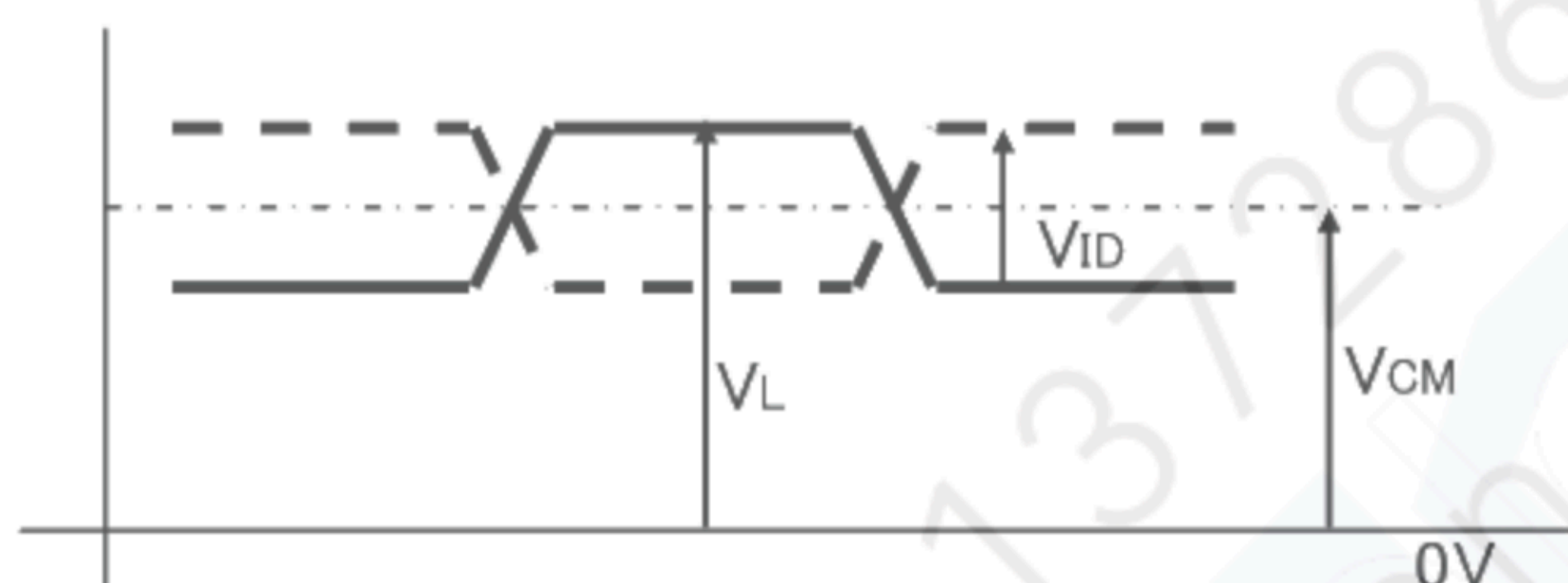


- 2) Display pattern:

 $V_{DD} = 3.3V, \text{Temp.} = 25^{\circ}C$ [illegible]

- 3) Input signal : MODE, SC

- 4) Input signal : RxIN3+, RxIN3-, RxIN2+, RxIN2-, RxIN1+, RxIN1-, RxIN0+, RxIN0-, CK IN+, CK IN-



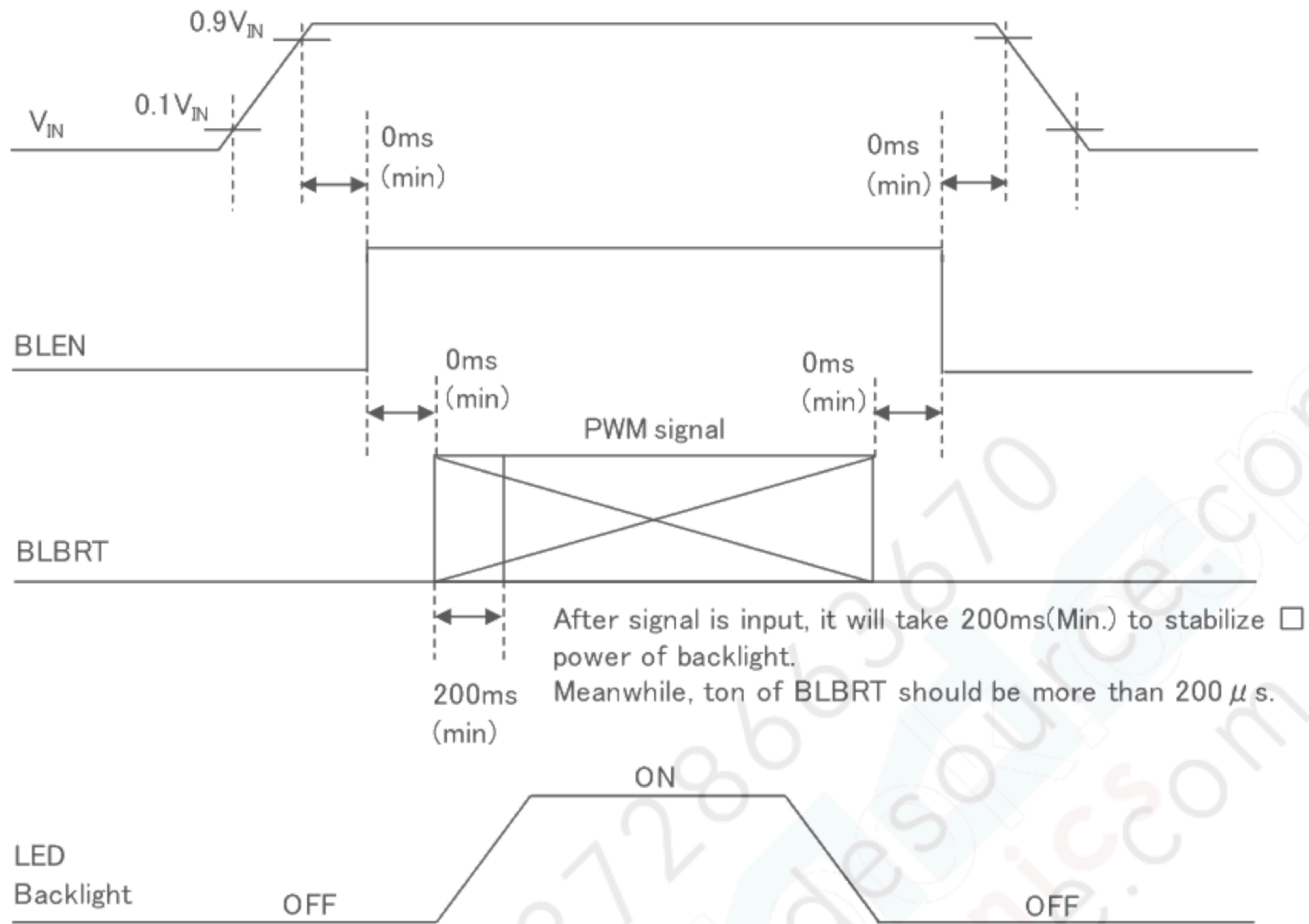
- 5) V_{CM} : LVDS Common mode voltage ($V_{CM}=1.25V$)

5-2. Constant current circuit for LED Backlight

Temp. = -30~80°C

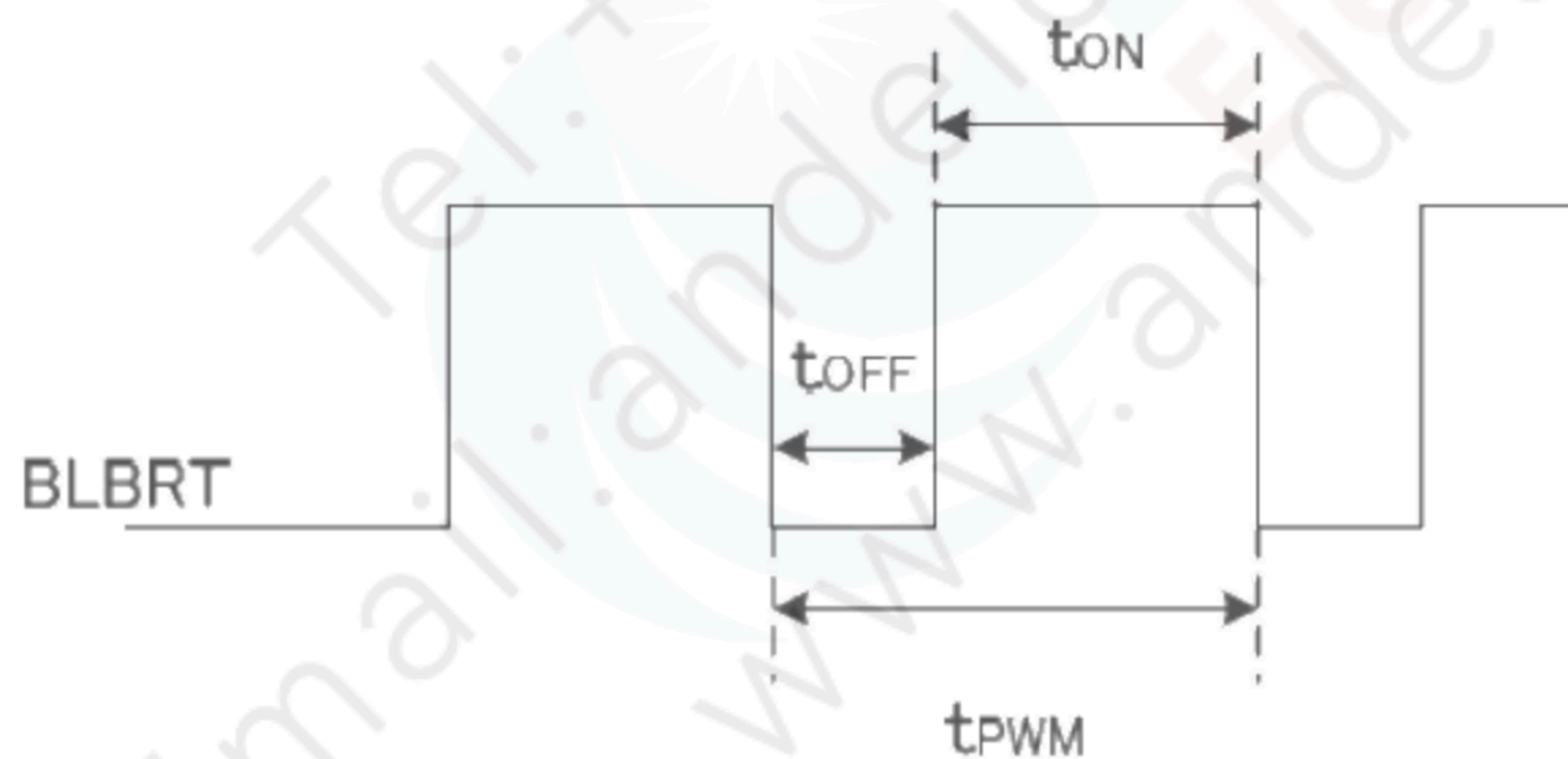
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage 1)	V_{IN}	-	(10.8)	(12.0)	(13.2)	V
Current consumption	I_{IN}	2)	-	(950)	(1235)	mA
Permissive input ripple voltage	V_{RP_BL}	$V_{IN}=12.0V$	-	-	(100)	mVp-p
BLBRT Input signal voltage	V_{IL_BLBRT}	"Low" level	(0)	-	(0.8)	V
	V_{IH_BLBRT}	"High" level	(2.3)	-	(V_{IN})	V
BLEN Input signal voltage	V_{IL_BLEN}	"Low" level	(0)	-	(0.8)	V
	V_{IH_BLEN}	"High" level	(2.3)	-	(V_{IN})	V
PWM Frequency 3)	f_{PWM}	-	(200)	-	(10k)	Hz
PWM Duty ratio 3)	D_{PWM}	$f_{PWM}=200Hz$	(1)	-	(100)	%
		$f_{PWM}=2kHz$	(10)	-	(100)	%
		$f_{PWM}=10kHz$	(50)	-	(100)	%
Operating life time 4), 5)	T	Temp.=25°C	-	(50,000)	-	h

- 1) V_{IN} -turn-on conditions



2) $V_{IN} = 12\text{V}$, Temp. = 25°C , $D_{PWM} = 100\%$

3) PWM Timing Diagram



$t_{ON}, t_{OFF} \geq 50\mu\text{s}$.

In case of lower frequency, the deterioration of the display quality, flicker etc., may occur.

4) When brightness decrease 50% of minimum brightness.

The average life of a LED will decrease when the LCD is operating at higher temperatures.

5) Life time is estimated data.(Condition : $D_{PWM} = 100\%$, $T_a = 25^{\circ}\text{C}$ in chamber).

6. Optical characteristics

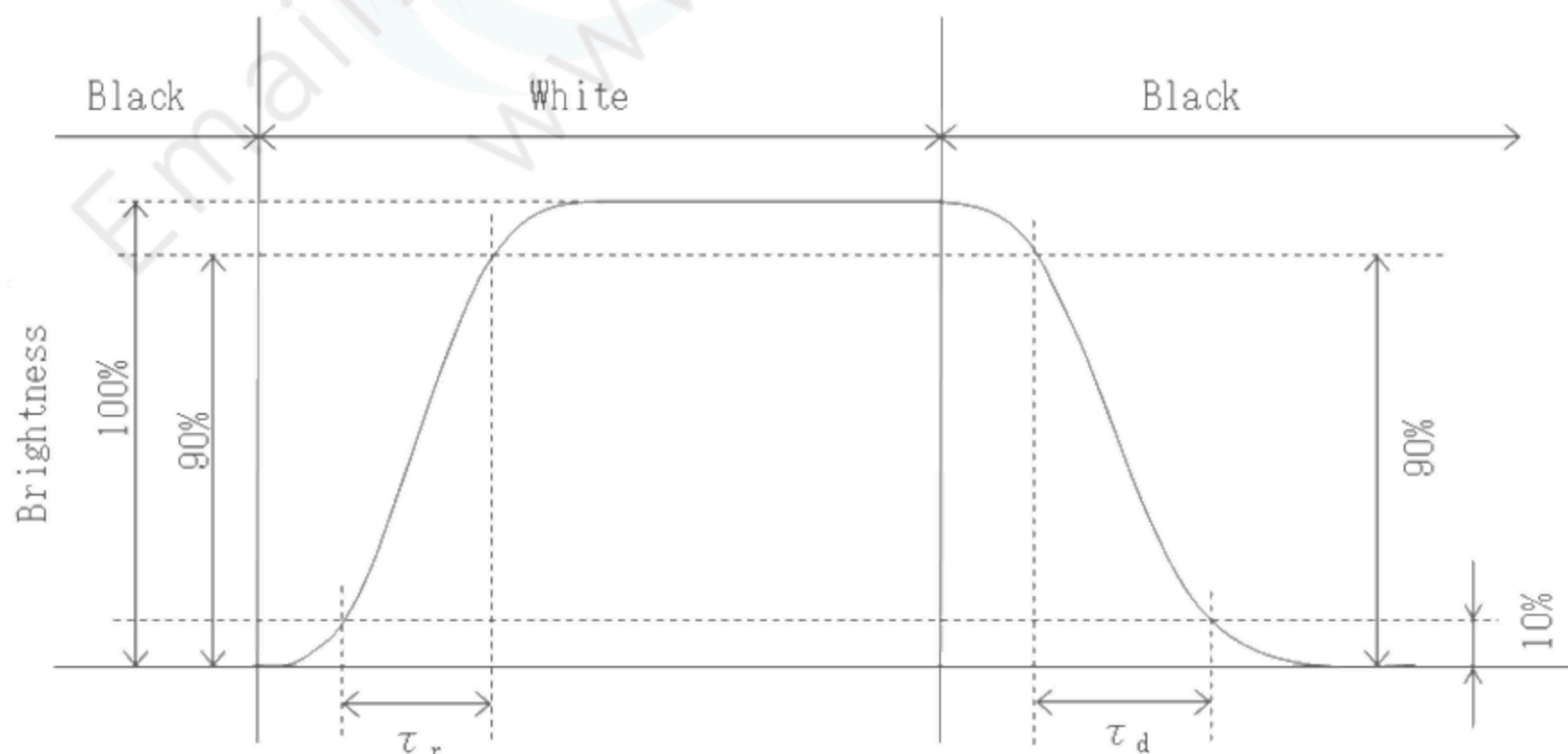
Measuring spot = ϕ 6.0mm, Temp. = 25°C

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Response time	Rise	τ_r	$\theta = \phi = 0^\circ$	—	(18)	—	ms
	Down	τ_d	$\theta = \phi = 0^\circ$	—	(12)	—	ms
Viewing angle range		θ_{UPPER}	$CR \geq 10$	—	(85)	—	deg.
		θ_{LOWER}		—	(85)	—	
		ϕ_{LEFT}		—	(85)	—	deg.
		ϕ_{RIGHT}		—	(85)	—	
Contrast ratio		CR	$\theta = \phi = 0^\circ$	(500)	(750)	—	-
Brightness		L	$D_{\text{PWM}} = 100\%$	—	(1500)	—	cd/m ²
Chromaticity coordinates	Red	x	$\theta = \phi = 0^\circ$	(0.550)	(0.600)	(0.650)	-
		y		(0.300)	(0.350)	(0.400)	
	Green	x	$\theta = \phi = 0^\circ$	(0.285)	(0.335)	(0.385)	
		y		(0.520)	(0.570)	(0.620)	
	Blue	x	$\theta = \phi = 0^\circ$	(0.100)	(0.150)	(0.200)	
		y		(0.070)	(0.120)	(0.170)	
	White	x	$\theta = \phi = 0^\circ$	(0.255)	(0.305)	(0.355)	
		y		(0.275)	(0.325)	(0.375)	

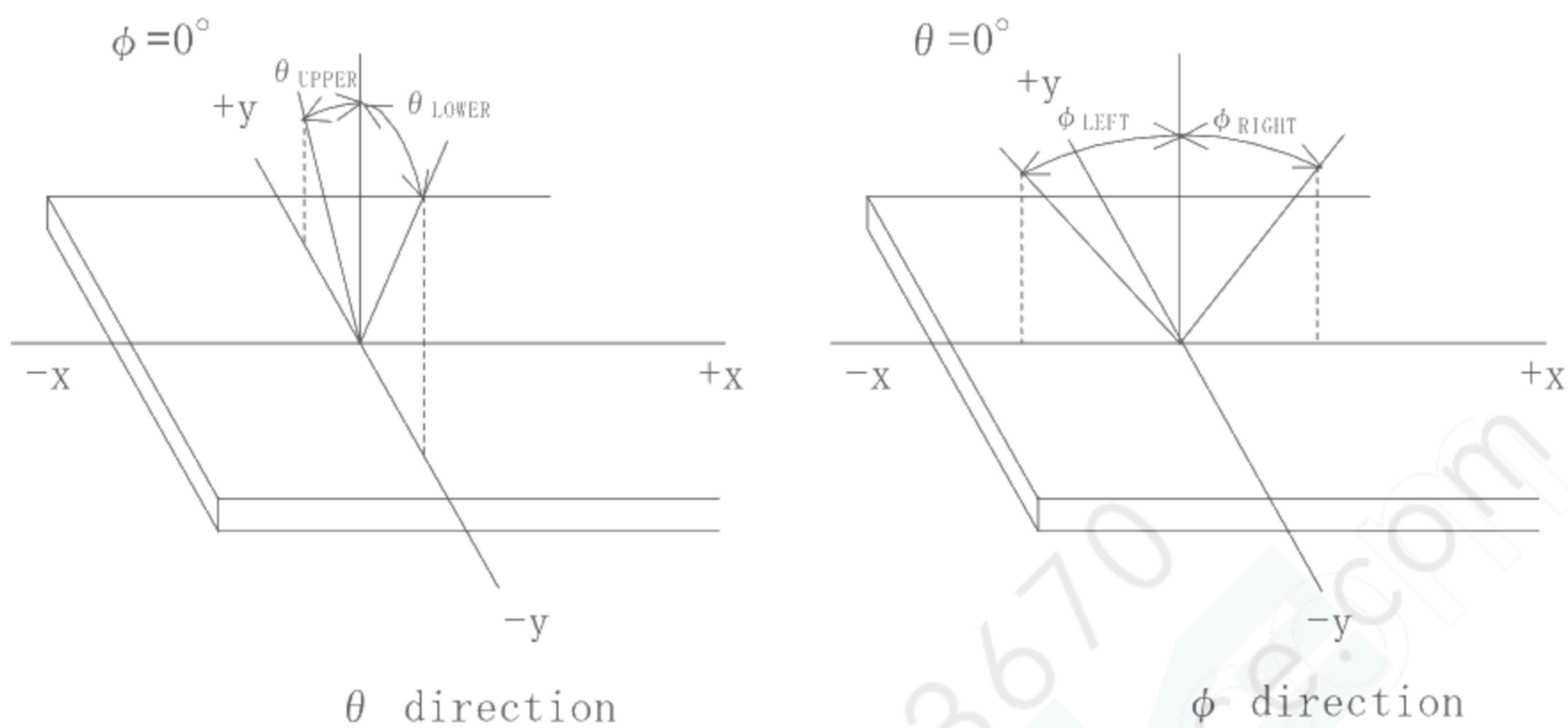
6-1. Definition of contrast ratio

$$CR(\text{Contrast ratio}) = \frac{\text{Brightness with all pixels "White"}}{\text{Brightness with all pixels "Black"}}$$

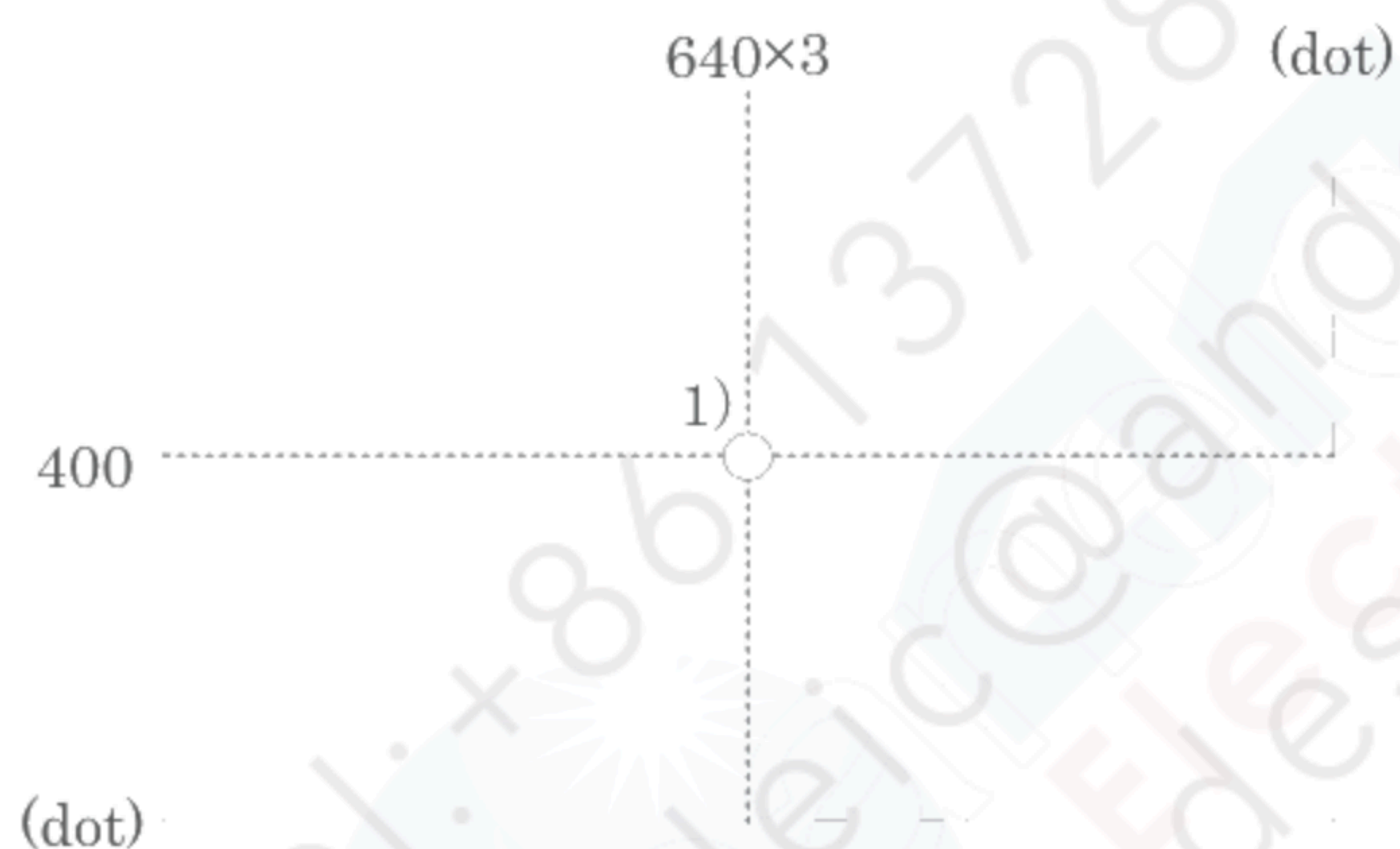
6-2. Definition of response time



6-3. Definition of viewing angle



6-4. Brightness measuring point



- 1) Rating is defined as the white brightness at center of display screen.
- 2) 5 minutes after LED is turned on. (Ambient Temp.=25°C)

7. Interface signals

7-1. Interface signals

No.	Symbol	Description	Note
1	VDD	+3.3V power supply	
2	VDD	+3.3V power supply	
3	GND	GND	
4	GND	GND	
5	RxIN0-	LVDS receiver signal CH0(-)	LVDS
6	RxIN0+	LVDS receiver signal CH0(+)	LVDS
7	GND	GND	
8	RxIN1-	LVDS receiver signal CH1(-)	LVDS
9	RxIN1+	LVDS receiver signal CH1(+)	LVDS
10	GND	GND	
11	RxIN2-	LVDS receiver signal CH2(-)	LVDS
12	RxIN2+	LVDS receiver signal CH2(+)	LVDS
13	GND	GND	
14	CK IN-	LVDS receiver signal CK(-)	LVDS
15	CK IN+	LVDS receiver signal CK(+)	LVDS
16	GND	GND	
17	RxIN3-	LVDS receiver signal CH3(-)	LVDS
18	RxIN3+	LVDS receiver signal CH3(+)	LVDS
19	MODE	LVDS mapping select signal (GND or Open: Link3 RGB[1:0] mode, High: Link3 RGB[7:6] mode)	
20	SC	Scan direction control (GND or Open : Normal, High : Reverse)	1)

LCD connector : 20186-020E-11F (I-PEX)

Matching connector : FI-S20S (JAE)

(EOL notification was issued for 20197-020U-F (I-PEX) and 20197-T20U-F (I-PEX).)

LVDS receiver : Embedded in ASIC

Matching LVDS transmitter : THC63LVDM83R(Thine Electronics) or compatible

1) Scanning

SC : GND or Open



SC : High



7-2. LED

No.	Symbol	Description	Note
1	V _{IN}	+12V power supply	
2	V _{IN}	+12V power supply	
3	BLBRT	PWM signal(Brightness adjustment)	
4	BLEN	ON/OFF terminal voltage	
5	GND	GND	
6	GND	GND	
7	GND	GND	
8	GND	GND	
9	V _{in}	+12V power supply	
10	V _{in}	+12V power supply	

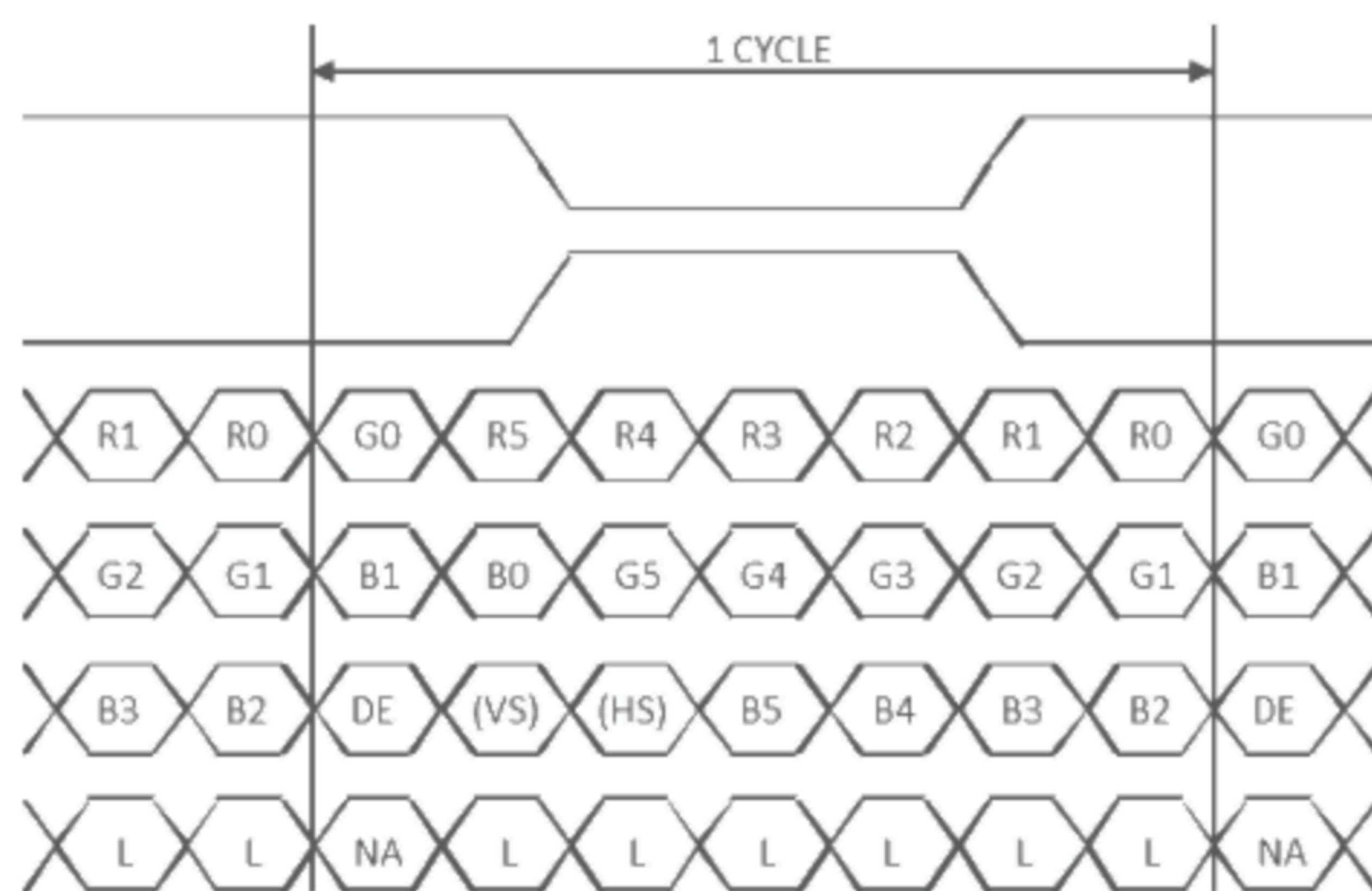
LCD connector : SM10B-SHLS-TF(LF)(SN) (JST)
Matching connector : SHLP-10V-S-B (JST)

7-3. Data mapping (6bit Input Mode)

1) Data Mapping (Transmitter : THC63LVDM83R(THine Electronics) or compatible)

Transmitter		19Pin MODE = "L" or OPEN
Pin No.	Data	
51	TA0	R0(LSB)
52	TA1	R1
54	TA2	R2
55	TA3	R3
56	TA4	R4
3	TA5	R5(MSB)
4	TA6	G0(LSB)
6	TB0	G1
7	TB1	G2
11	TB2	G3
12	TB3	G4
14	TB4	G5(MSB)
15	TB5	B0(LSB)
19	TB6	B1
20	TC0	B2
22	TC1	B3
23	TC2	B4
24	TC3	B5(MSB)
27	TC4	(HS)
28	TC5	(VS)
30	TC6	DE
50	TD0	GND
2	TD1	GND
8	TD2	GND
10	TD3	GND
16	TD4	GND
18	TD5	GND
25	TD6	GND

MODE=L(GND) or OPEN



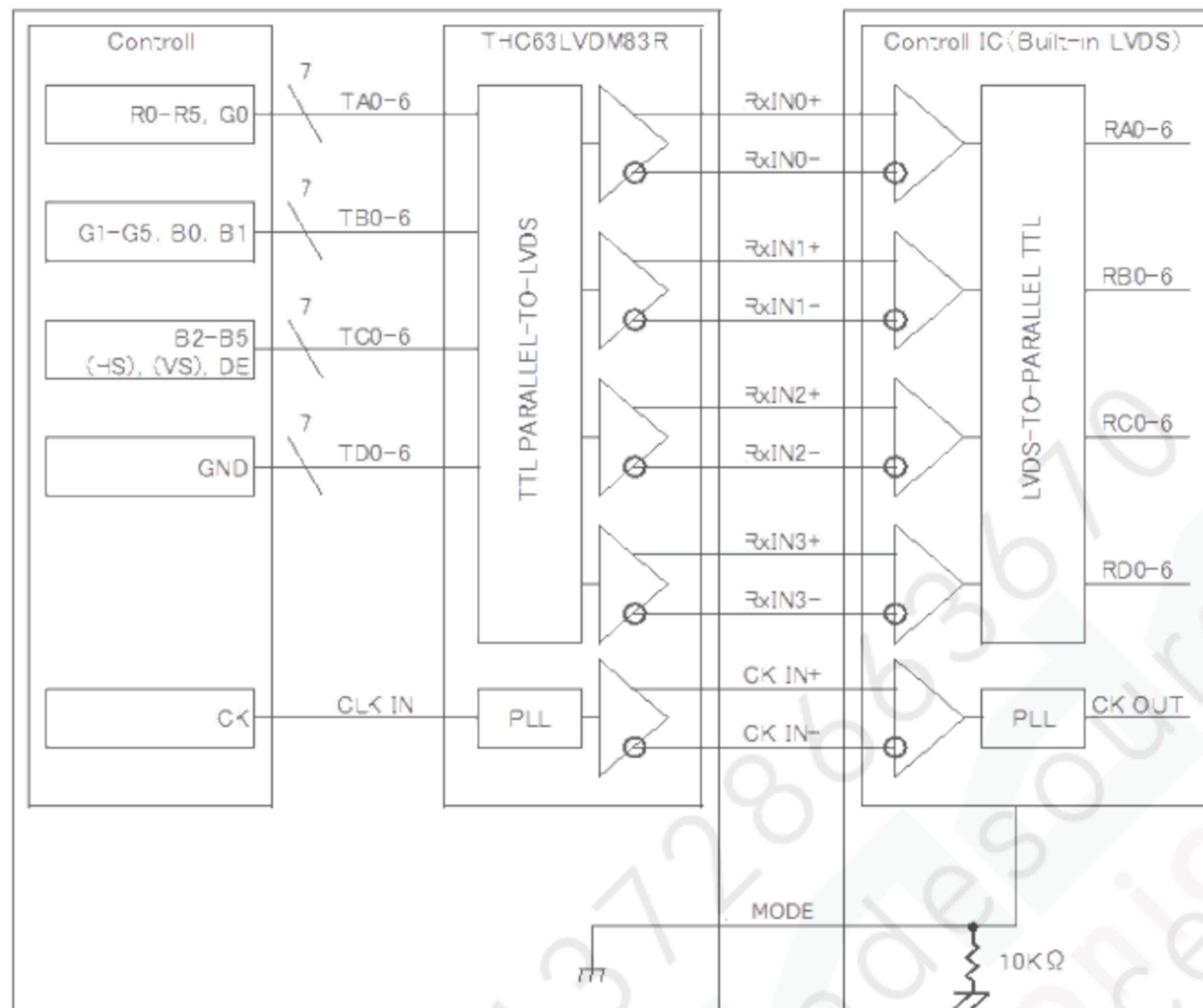
DE : DATA ENABLE

HS : H_{SYNC}

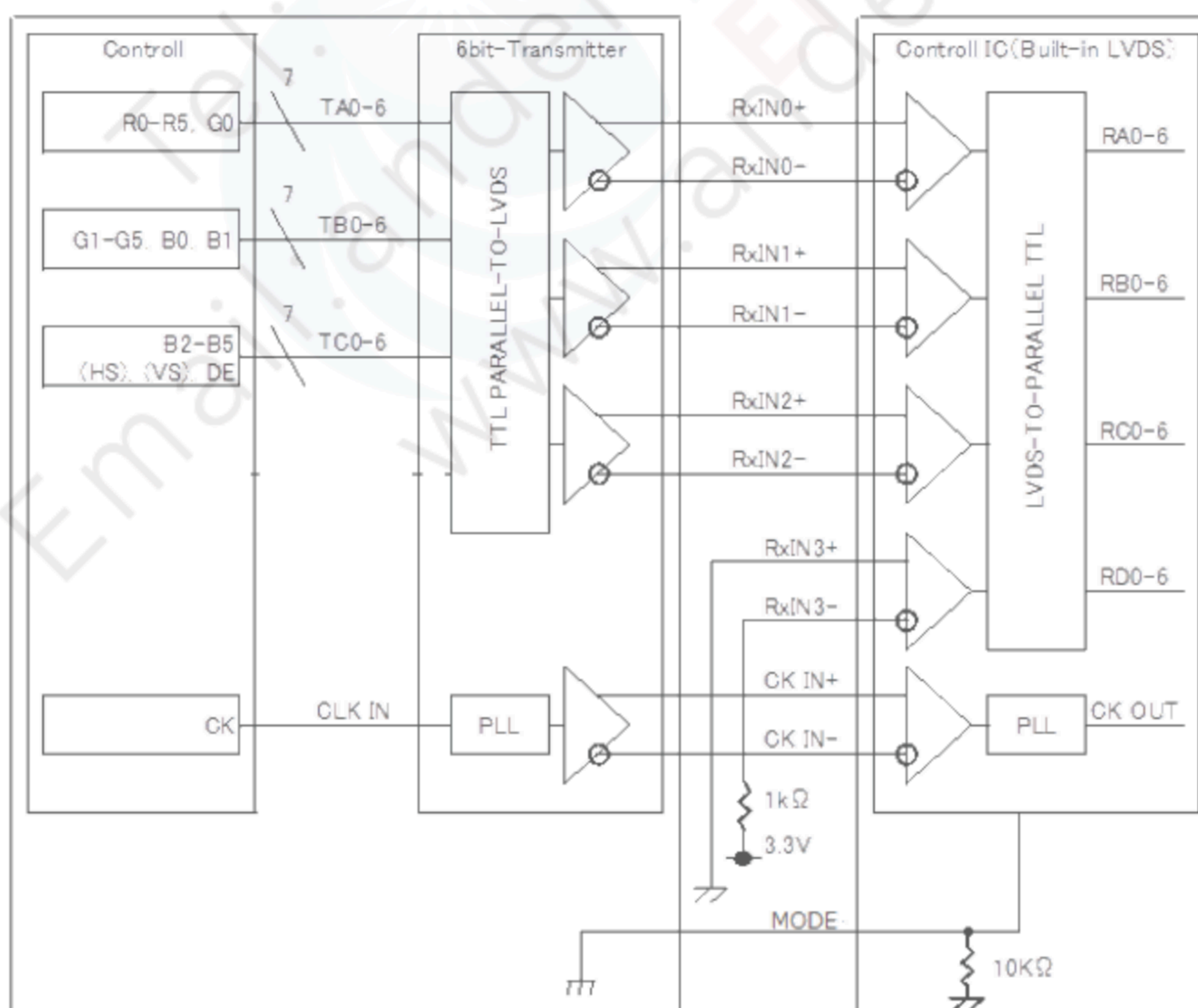
VS : V_{SYNC}

2) Block Diagram

MODE=L(GND) or OPEN



When using “6-bit Transmitter”, please connect the unused channel of the control IC receiver as described in the diagram below.

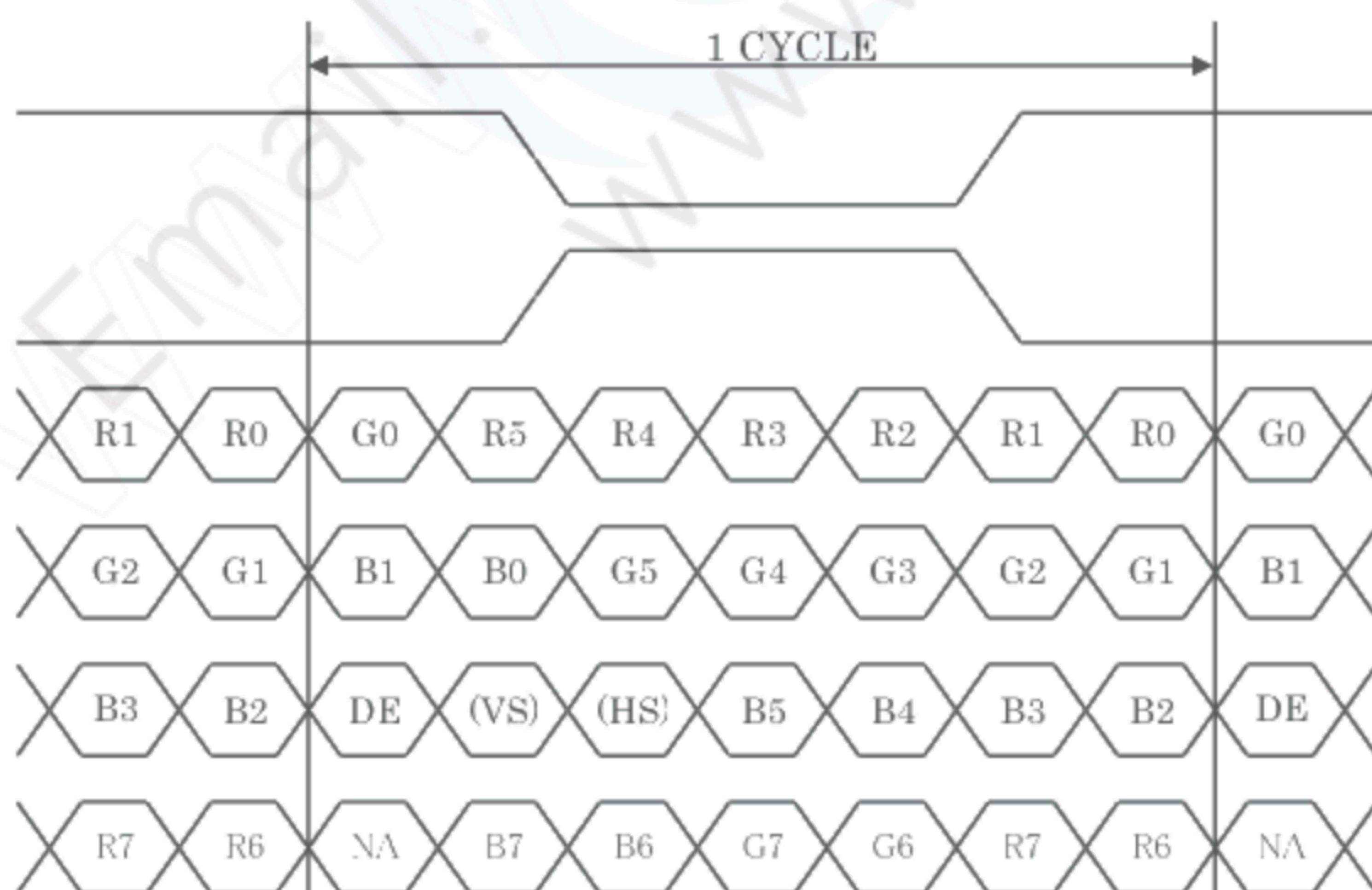


7-4. Data mapping (8bit Input Mode)

1) Data Mapping (Transmitter : THC63LVDM83R(THine Electronics) or compatible)

Transmitter		19Pin MODE = "H"	19Pin MODE = "L" or OPEN
Pin No.	Data		
51	TA0	R0(LSB)	R2
52	TA1	R1	R3
54	TA2	R2	R4
55	TA3	R3	R5
56	TA4	R4	R6
3	TA5	R5	R7(MSB)
4	TA6	G0(LSB)	G2
6	TB0	G1	G3
7	TB1	G2	G4
11	TB2	G3	G5
12	TB3	G4	G6
14	TB4	G5	G7(MSB)
15	TB5	B0(LSB)	B2
19	TB6	B1	B3
20	TC0	B2	B4
22	TC1	B3	B5
23	TC2	B4	B6
24	TC3	B5	B7(MSB)
27	TC4	(HS)	(HS)
28	TC5	(VS)	(VS)
30	TC6	DE	DE
50	TD0	R6	R0(LSB)
2	TD1	R7(MSB)	R1
8	TD2	G6	G0(LSB)
10	TD3	G7(MSB)	G1
16	TD4	B6	B0(LSB)
18	TD5	B7(MSB)	B1
25	TD6	(NA)	(NA)

MODE=H

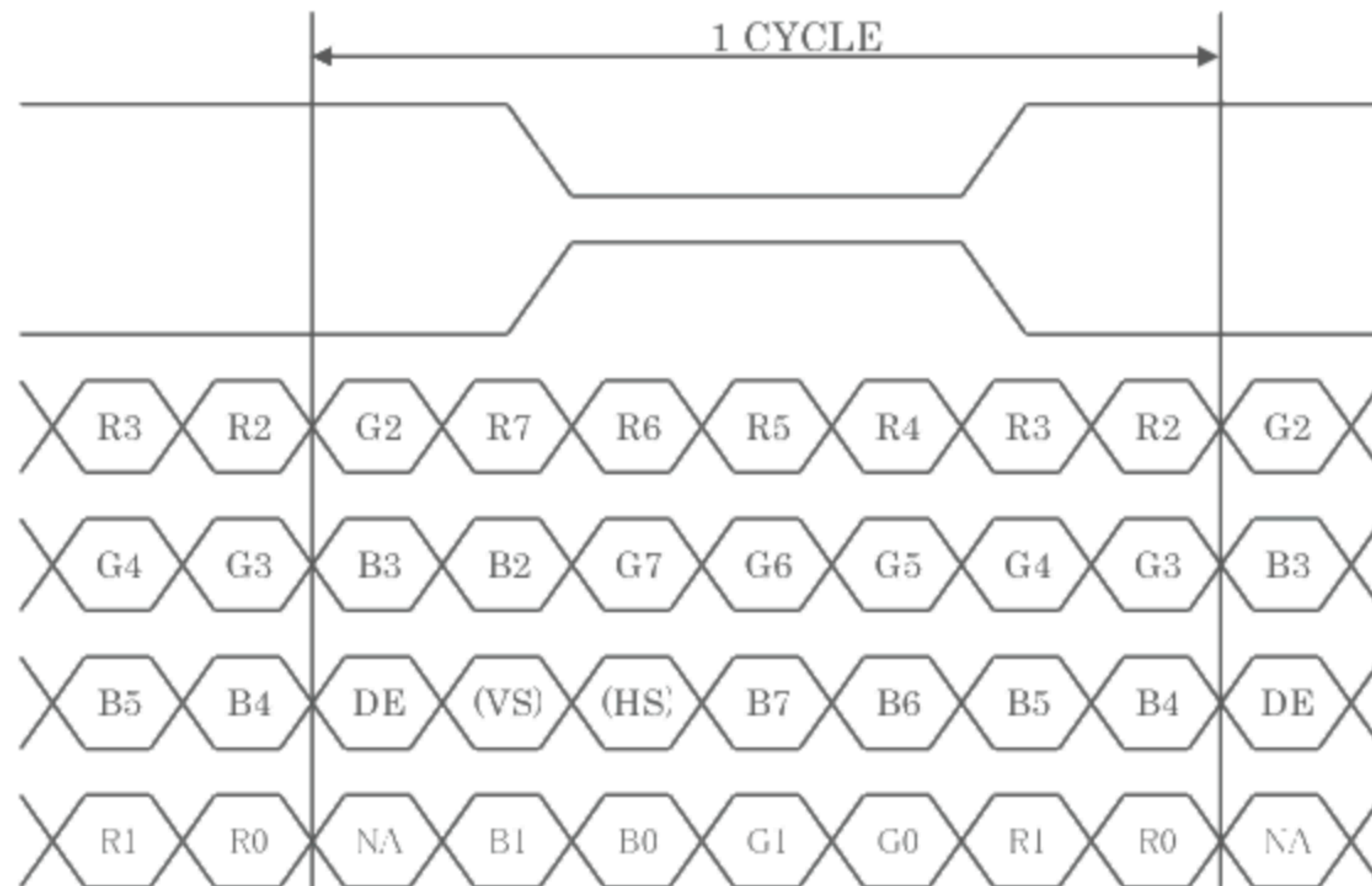


DE : DATA ENABLE

HS : H_{SYNC}

VS : V_{SYNC}

MODE = L(GND) or OPEN



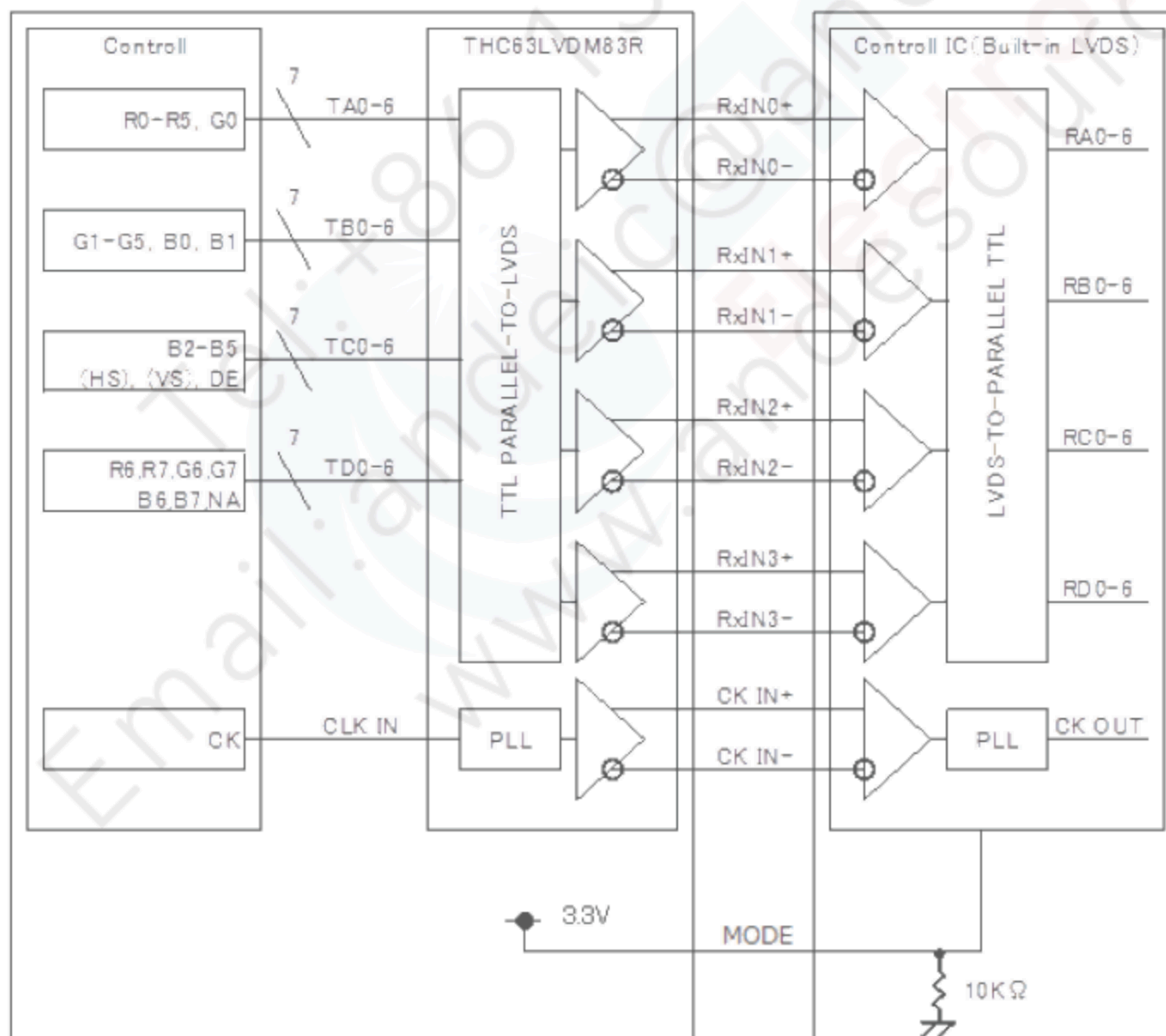
DE : DATA ENABLE

HS : H_{SYNC}

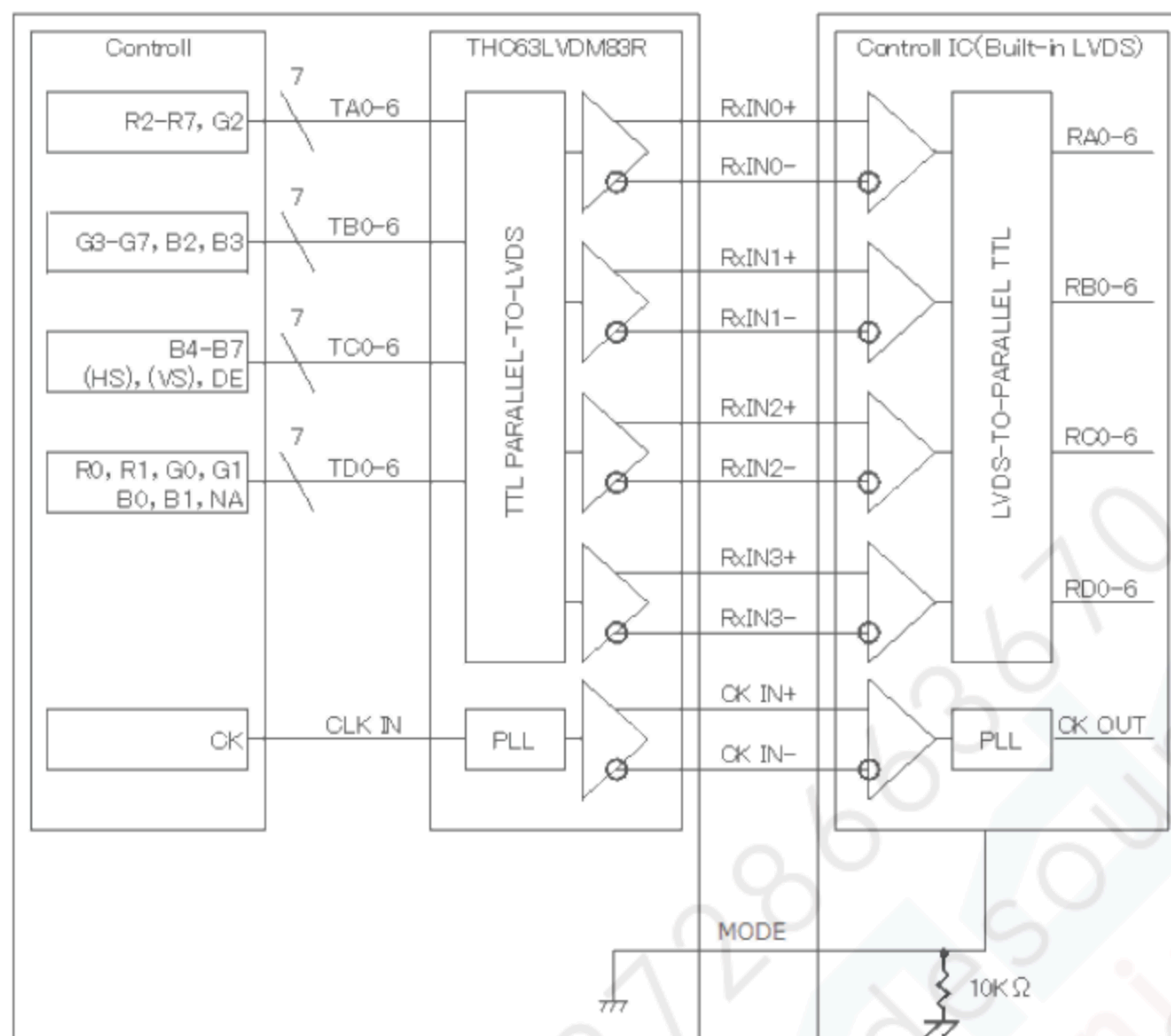
VS : V_{SYNC}

2) Block Diagram

MODE=H



MODE=L(GND) or OPEN



8. Input timing characteristics

8-1. Timing characteristics 1)

	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Clock (CK)	Frequency	1/Tc	(60)	(71.1)	(80)	MHz	
Enable signal (DE)	Horizontal Period	Th	(1300)	(1440)	(1800)	Dot	
			(16.25)	(20.25)	-	μs	2)
	Horizontal display period	Thd	(1280)				
	Vertical Period	Tv	(803)	(823)	(1024)	Line	
	Vertical display period	Tvd	(800)				
Refresh rate		fv	(50)	(60)	(70)	—	3)

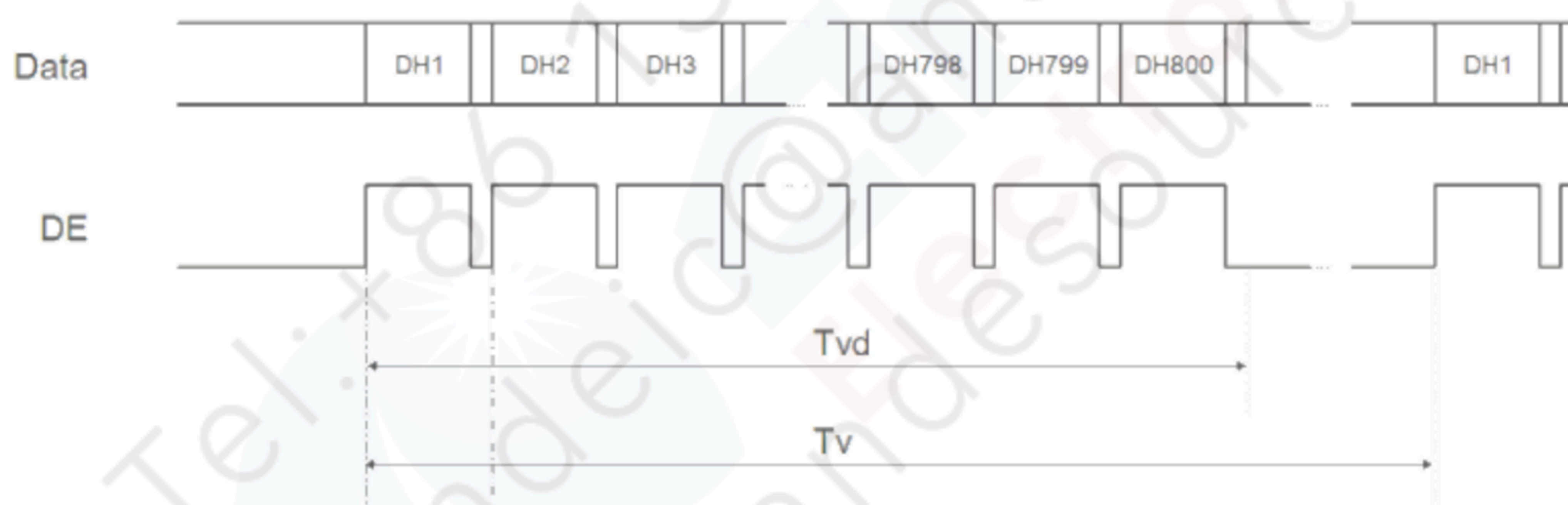
1) If the display is used under the condition which is out of specifications such as higher clock frequency than specified value, there is a possibility phenomenon such as display error including white display, malfunction and no image may occur.

Please use the display under the conditions written in the specification.

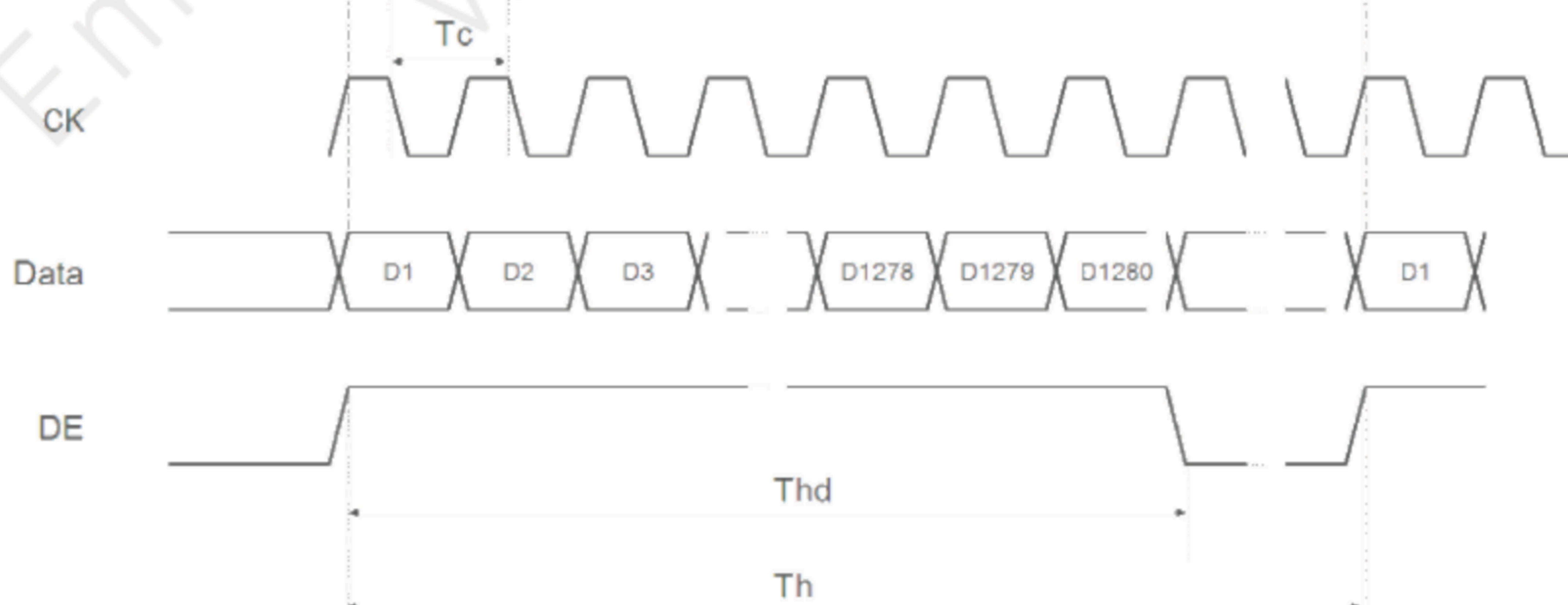
2) Please set a clock frequency, a vertical dormant period, and the horizontal dormant period so that the Horizontal Period should not reach less than Min. value.

3) If the refresh rate reach less than Min. value, the deterioration of the display quality, flicker etc., may occur.(fv=1/Tv)

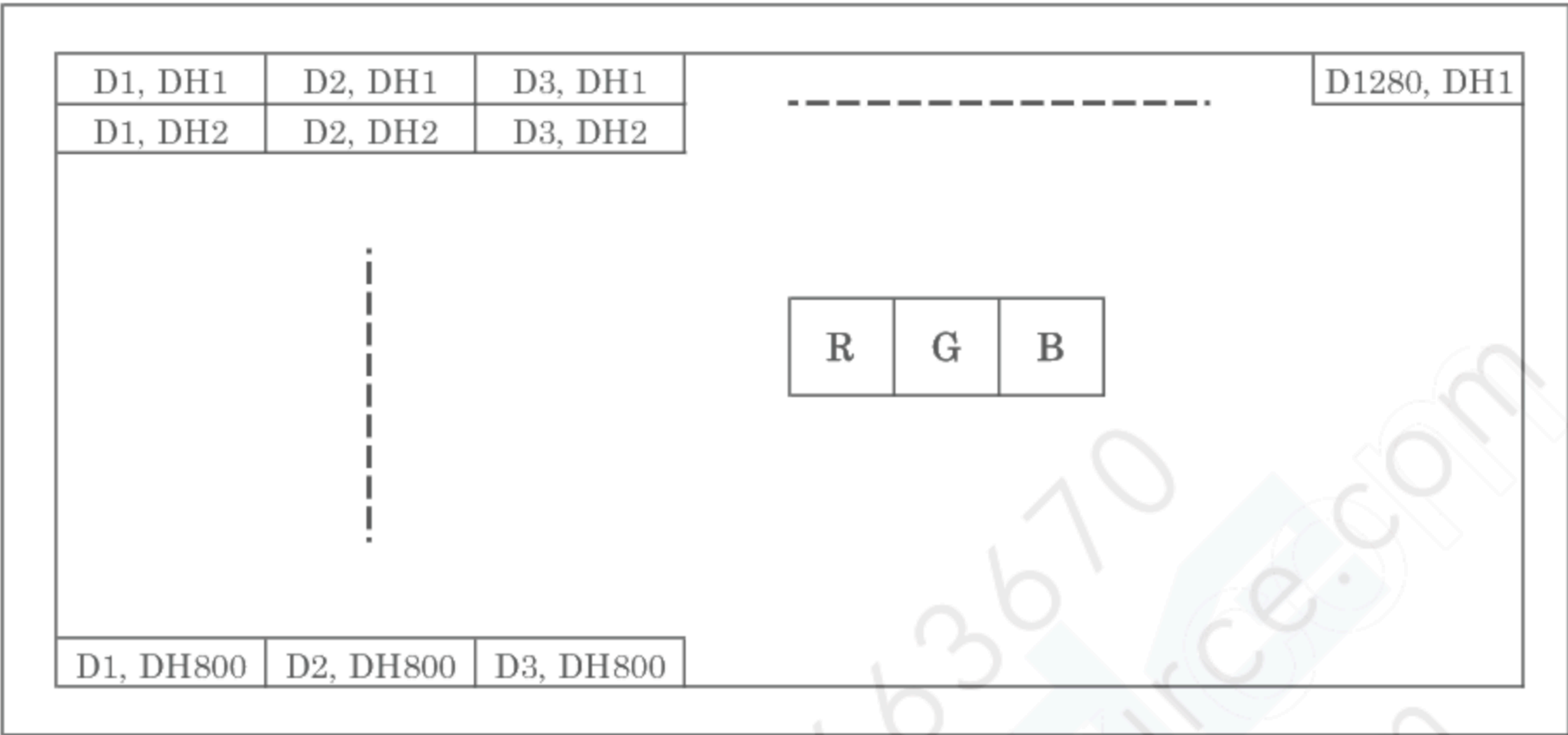
Vertical Timing Diagram



Horizontal Timing Diagram

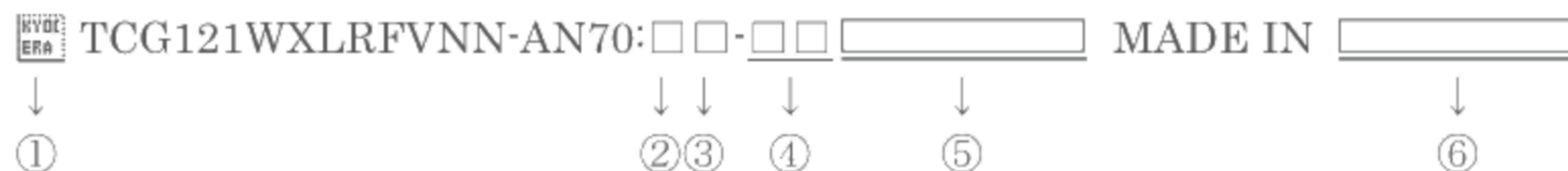


8-2. Input data signals and display position on the screen



9. Lot number identification

The lot number shall be indicated on the back of the backlight case of each LCD.



No① – No⑥ above indicate

- ① Data matrix (For internal control purpose only)
(The items from Part No. to Version No. are included in data matrix.)
- ② Year code
- ③ Month code
- ④ Day code
- ⑤ Version number (Max. 7 characters)
- ⑥ Country of origin

② Year code: the last digit of the year
e.g. In case of 2019, year code: 9

③ Month code

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.
Code	1	2	3	4	5	6

Month	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Code	7	8	9	X	Y	Z

10. Warranty

10-1. Incoming inspection

Please inspect the LCD within one month after your receipt.

10-2. Production warranty

Kyocera warrants its LCD's for a period of 12 months from the ship date. Kyocera shall, by mutual agreement, replace or re-work defective LCD's that are shown to be Kyocera's responsibility.

11. Precautions for use

11-1. Installation of the LCD

- 1) Please ground in order to stabilize brightness and display quality.
- 2) A transparent protection plate shall be added to protect the LCD and its polarizer.
- 3) The LCD shall be installed so that there is no pressure on the LSI chips.
- 4) Since this product is wide viewing product, occurrence level of in-plane unevenness by the external stress is different compared to current normal viewing product. So there is a possibility that in-plane unevenness will be occurred by over twist, strain giving by attaching to LCD, and over pressure to touch panel. Please be careful of stress when designing the housing.
- 5) A transparent protection sheet is attached to the polarizer.
Please remove the protection film slowly before use, paying attention to static electricity.

11-2. Static electricity

- 1) Since CMOS ICs are mounted directly onto the LCD glass, protection from static electricity is required.
- 2) Workers should use body grounding. Operator should wear ground straps.

11-3. LCD operation

- 1) The LCD shall be operated within the limits specified. Operation at values outside of these limits may shorten life, and/or harm display images.
- 2) Please select the best display pattern based on your evaluation because flicker, lines or nonuniformity or unevenness can be visible depending on display patterns.

11-4. Storage

- 1) The LCD shall be stored within the temperature and humidity limits specified.
Store in a dark area, and protect the LCD from direct sunlight or fluorescent light.
- 2) Always store the LCD so that it is free from external pressure onto it.

11-5. Usage

- 1) **DO NOT** store in a high humidity environment for extended periods. Polarizer degradation bubbles, and/or peeling off of the polarizer may result.
- 2) The front polarizer is easily scratched or damaged. Prevent touching it with any hard material, and from being pushed or rubbed.
- 3) The LCD screen may be cleaned by wiping the screen surface with a soft cloth or cotton pad using a little Ethanol.
- 4) Water may cause damage or discoloration of the polarizer. Clean condensation or moisture from any source immediately.
- 5) Always keep the LCD free from condensation during testing. Condensation may permanently spot or stain the polarizer.
- 6) Do not disassemble LCD because it will result in damage.
- 7) This Kyocera LCD has been specifically designed for use in general electronic devices, but not for use in a special environment such as usage in an active gas. Hence, when the LCD is supposed to be used in a special environment, evaluate the LCD thoroughly beforehand and do not expose the LCD to chemicals such as an active gas.
- 8) Please do not use solid-base image pattern for long hours because a temporary afterimage may appear. We recommend using screen saver etc. in cases where a solid-base image pattern must be used.
- 9) Liquid crystal may leak when the LCD is broken. Be careful not to let the fluid go into your eyes and mouth. In the case the fluid touches your body; rinse it off right away with water and soap.

12. Reliability test data

Test item	Test condition	Test time	Judgement
High temp. atmosphere	80°C	240h	Display function : No defect Display quality : No defect Current consumption : No defect
Low temp. atmosphere	-30°C	240h	Display function : No defect Display quality : No defect Current consumption : No defect
High temp. humidity atmosphere	40°C 90% RH	240h	Display function : No defect Display quality : No defect Current consumption : No defect
Temp. cycle	-30°C 0.5h R.T. 0.5h 80°C 0.5h	10cycles	Display function : No defect Display quality : No defect Current consumption : No defect
High temp. operation	80°C	500h	Display function : No defect Display quality : No defect Current consumption : No defect

- 1) Each test item uses a test LCD only once. The tested LCD is not used in any other tests.
- 2) The LCD is tested in circumstances in which there is no condensation.
- 3) The reliability test is not an out-going inspection.
- 4) The result of the reliability test is for your reference purpose only.
The reliability test is conducted only to examine the LCD's capability.

Material 材質		Treatment 処理	Approved '19.11.13	Checked	Checked '19.11.12	Drawn	Scale 1:1(NTS)	Title TCG121WXLRFVNN-AN70	Year-Month-Day '19.11.11		Size 2
Quantity 製作数		Description; R-O-T-S 備考 15092-12080-1	半佐美		倉元	蓋止		Outline Dimensions	121A9010000		1/2
1	2	3	4	5	8	9	10	11	12		

Spec No.	TQ3C-8EAF0-E2YAM44-00
Date	November 13, 2019

KYOCERA INSPECTION STANDARD

TYPE : TCG121WXLRFVNN-AN70

KYOCERA CORPORATION

Original Issue Date	Designed by : Engineering dept.			Confirmed by : QA dept.	
	Prepared	Checked	Approved	Checked	Approved
November 13, 2019	<i>K. Fudo</i>	<i>M. Iwasaki</i>	<i>A. Iwasaki</i>	<i>S. Kishimoto</i>	<i>D. Sato</i>

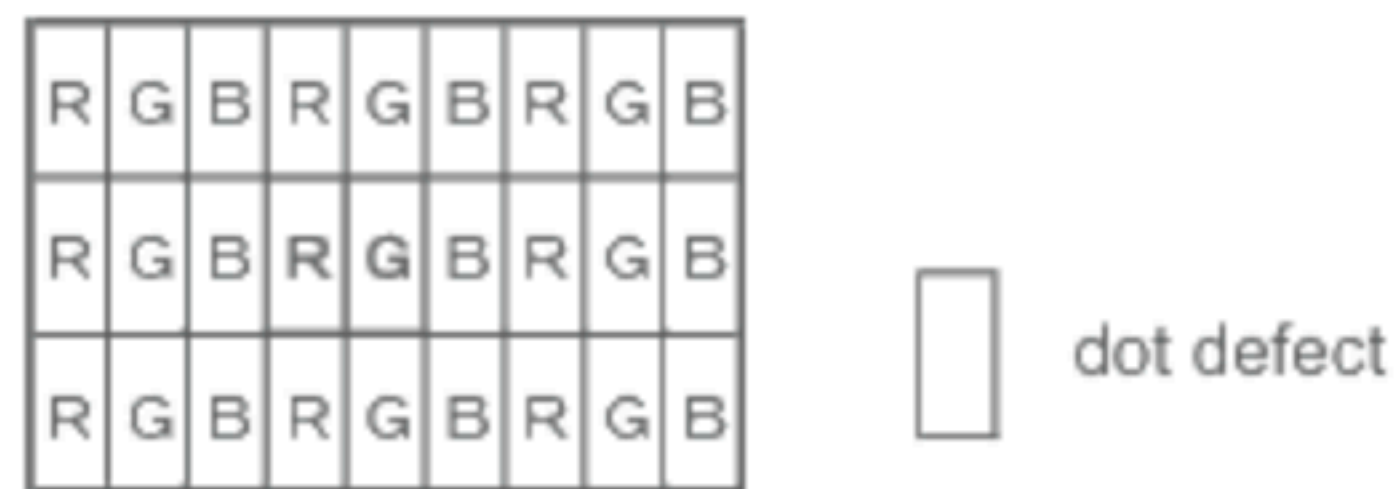
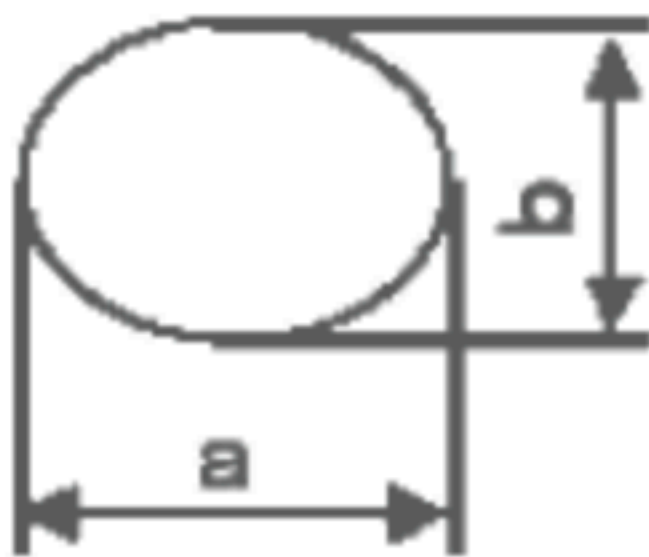
Spec No. TQ3C-8EAF0-E2YAM44-00	Part No. TCG121WXLRFVNN-AN70	Page -
-----------------------------------	---------------------------------	-----------

Revision record

Date		Designed by : Engineering dept.			Confirmed by : QA dept.	
		Prepared	Checked	Approved	Checked	Approved
Rev.No.	Date	Page	Descriptions			

Visuals specification

1) Note

	Note		
General	1. Customer identified anomalies not defined within this inspection standard shall be reviewed by Kyocera, and an additional standard shall be determined by mutual consent. 2. This inspection standard about the image quality shall be applied to any defect within the effective active area and shall not be applicable to outside of the area. 3. Inspection conditions Luminance : 500 Lux min. Inspection distance : 300 mm. Temperature : $25 \pm 5^{\circ}\text{C}$ Direction : Directly above		
Definition of inspection item	Dot defect	Bright dot defect	The dot is constantly "on" when power applied to the LCD, even when all "Black" data sent to the screen. Inspection tool: 5% Transparency neutral density filter. Count dot: If the dot is visible through the filter. Don't count dot: If the dot is not visible through the filter. 
		Black dot defect	The dot is constantly "off" when power applied to the LCD, even when all "White" data sent to the screen. Similar size compared to bright dot.
		White dot (Circular/foreign particle)	Pixel works electrically, however, circular/foreign particle makes dot appear to be "on" even when all "Black" data is sent to the screen.
		Adjacent dot	Adjacent dot defect is defined as two or more bright dot defects or black dot defects. 
	External inspection	Bubble, Scratch, Foreign particle (Polarizer, Cell, Backlight)	Visible operating (all pixels "Black" or "White") and non operating.
		Appearance inspection	Does not satisfy the value at the spec.
	Others	CFL wires	Damaged to the CFL wires, connector, pin, functional failure or appearance failure.
Definition of size	Definition of circle size  $d = (a + b) / 2$ Definition of linear size 		

2) Standard

Classification		Inspection item		Judgement standard																
Defect (in LCD glass)	Dot defect	Bright dot defect		Acceptable number : 4 Bright dot spacing : 5 mm or more																
		Black dot defect		Acceptable number : 5 Black dot spacing : 5 mm or more																
		2 dot join	Bright dot defect	Acceptable number : 2																
			Black dot defect	Acceptable number : 3																
		3 or more dots join		Acceptable number : 0																
		Total dot defects		Acceptable number : 5 Max																
	Others	White dot, Dark dot (Circle)		<table><tr><th>Size (mm)</th><th>Acceptable number</th></tr><tr><td>$d \leq 0.2$</td><td>(Neglected)</td></tr><tr><td>$0.2 < d \leq 0.4$</td><td>5</td></tr><tr><td>$0.4 < d \leq 0.5$</td><td>3</td></tr><tr><td>$0.5 < d$</td><td>0</td></tr></table>			Size (mm)	Acceptable number	$d \leq 0.2$	(Neglected)	$0.2 < d \leq 0.4$	5	$0.4 < d \leq 0.5$	3	$0.5 < d$	0				
		Size (mm)	Acceptable number																	
		$d \leq 0.2$	(Neglected)																	
		$0.2 < d \leq 0.4$	5																	
$0.4 < d \leq 0.5$		3																		
$0.5 < d$	0																			
External inspection (Defect on Polarizer or between Polarizer and LCD glass)		Polarizer (Scratch)		<table><tr><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable number</th></tr><tr><td>$W \leq 0.1$</td><td>—</td><td>(Neglected)</td></tr><tr><td rowspan="2">$0.1 < W \leq 0.3$</td><td>$L \leq 5.0$</td><td>(Neglected)</td></tr><tr><td>$5.0 < L$</td><td>0</td></tr><tr><td>$0.3 < W$</td><td>—</td><td>0</td></tr></table>			Width (mm)	Length (mm)	Acceptable number	$W \leq 0.1$	—	(Neglected)	$0.1 < W \leq 0.3$	$L \leq 5.0$	(Neglected)	$5.0 < L$	0	$0.3 < W$	—	0
		Width (mm)	Length (mm)	Acceptable number																
		$W \leq 0.1$	—	(Neglected)																
		$0.1 < W \leq 0.3$	$L \leq 5.0$	(Neglected)																
			$5.0 < L$	0																
		$0.3 < W$	—	0																
		Polarizer (Bubble)		<table><tr><th>Size (mm)</th><th>Acceptable number</th></tr><tr><td>$d \leq 0.2$</td><td>(Neglected)</td></tr><tr><td>$0.2 < d \leq 0.3$</td><td>5</td></tr><tr><td>$0.3 < d \leq 0.5$</td><td>3</td></tr><tr><td>$0.5 < d$</td><td>0</td></tr></table>			Size (mm)	Acceptable number	$d \leq 0.2$	(Neglected)	$0.2 < d \leq 0.3$	5	$0.3 < d \leq 0.5$	3	$0.5 < d$	0				
		Size (mm)	Acceptable number																	
		$d \leq 0.2$	(Neglected)																	
		$0.2 < d \leq 0.3$	5																	
$0.3 < d \leq 0.5$	3																			
$0.5 < d$	0																			
Foreign particle (Circular shape)		<table><tr><th>Size (mm)</th><th>Acceptable number</th></tr><tr><td>$d \leq 0.2$</td><td>(Neglected)</td></tr><tr><td>$0.2 < d \leq 0.4$</td><td>5</td></tr><tr><td>$0.4 < d \leq 0.5$</td><td>3</td></tr><tr><td>$0.5 < d$</td><td>0</td></tr></table>			Size (mm)	Acceptable number	$d \leq 0.2$	(Neglected)	$0.2 < d \leq 0.4$	5	$0.4 < d \leq 0.5$	3	$0.5 < d$	0						
Size (mm)	Acceptable number																			
$d \leq 0.2$	(Neglected)																			
$0.2 < d \leq 0.4$	5																			
$0.4 < d \leq 0.5$	3																			
$0.5 < d$	0																			
Foreign particle (Linear shape) Scratch		<table><tr><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable number</th></tr><tr><td>$W \leq 0.03$</td><td>—</td><td>(Neglected)</td></tr><tr><td rowspan="3">$0.03 < W \leq 0.1$</td><td>$L \leq 2.0$</td><td>(Neglected)</td></tr><tr><td>$2.0 < L \leq 4.0$</td><td>3</td></tr><tr><td>$4.0 < L$</td><td>0</td></tr><tr><td>$0.1 < W$</td><td>—</td><td>(According to circular shape)</td></tr></table>			Width (mm)	Length (mm)	Acceptable number	$W \leq 0.03$	—	(Neglected)	$0.03 < W \leq 0.1$	$L \leq 2.0$	(Neglected)	$2.0 < L \leq 4.0$	3	$4.0 < L$	0	$0.1 < W$	—	(According to circular shape)
Width (mm)	Length (mm)	Acceptable number																		
$W \leq 0.03$	—	(Neglected)																		
$0.03 < W \leq 0.1$	$L \leq 2.0$	(Neglected)																		
	$2.0 < L \leq 4.0$	3																		
	$4.0 < L$	0																		
$0.1 < W$	—	(According to circular shape)																		
Color variation (Mura)		Not to be significantly visible. Consultation shall be held as necessary.																		