



# SPECIFICATION

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**AC133UT1(AA1020-NCA)**

13.3" – 1600 x 1200 – TTL – Color (ACeP)

Version: 1.0

Date: 22.10.2020

Note: This specification is subject to change without prior notice

Version: 1.0

**TECHNICAL SPECIFICATION**

**MODEL NO: AA1020-NCA  
(AC133UT1)**

The content of this information is subject to be changed without notice.  
Please contact E Ink or its agent for further information.

Customer's Confirmation

Customer \_\_\_\_\_

Date \_\_\_\_\_

By \_\_\_\_\_

E Ink's Confirmation

Approve By 蔡子剛 2020.10.27

Confirmed By 陳若嘉 2020.10.27

Prepared By 曾亞琴 2020.10.22

## Revision History

Rev.	Issued Date	Revised Contents
1.0	2020/10/22	Release Version

# ***TECHNICAL SPECIFICATION***

## **CONTENTS**

<b><i>NO.</i></b>	<b><i>ITEM</i></b>	<b><i>PAGE</i></b>
-	Cover	1
-	Revision History	2
-	Contents	3
1	General Description	4
2	Features	4
3	Mechanical Specifications	4
4	Mechanical Drawing of Display Module	5
5	Input / Output Interface	6
6	Electrical Characteristics	8
7	Power Sequence	15
8	Optical Characteristics	17
9	Handling, Safety and Environment Requirements	20
10	Reliability test	22
11	Block Diagram	23
12	Packing	24
13	Bar Code definition	25

## 1. General Description

AC133UT1 is a reflective electrophoretic E Ink® Advanced Color ePaper (ACeP®) technology display module based on active matrix TFT substrate. The diagonal length of active area is 13.3” and contains 1600 x 1200 pixels. The display is capable to display full color images depending on the display controller and the associated lookup table used.

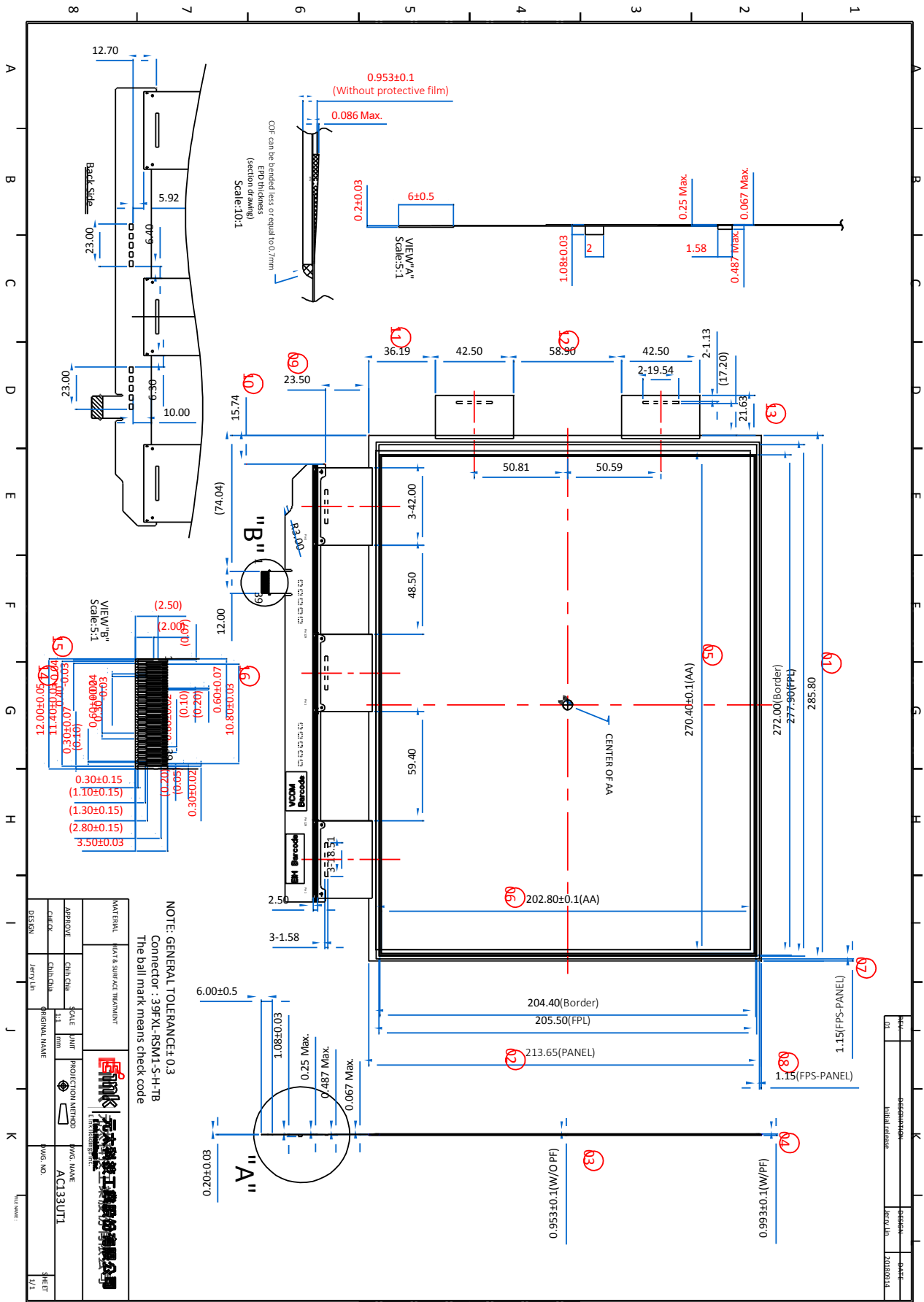
## 2. Features

- Full color display
- High contrast
- High reflectance
- Ultra-wide viewing angle
- Pure reflective mode
- Image stable
- Commercial temperature range (15 ~ 35 °C)
- Landscape/Portrait mode
- Antiglare hard-coated front-surface

## 3. Mechanical Specifications

Parameter	Specifications	Unit	Remark
Screen Size	13.3	Inch	
Display Resolution	1600(H) × 1200(V)	Pixel	DPI: 150
Active Area	270.4(H) × 202.8(V)	mm	
Pixel Pitch	0.169(H) × 0.169(V)	mm	
Pixel Configuration	Rectangle		
Outline Dimension	285.8(W) × 213.65(H) × 0.97(D)	mm	w/o masking film
Module Weight	110 ± 10	g	
Display operating mode	Reflective mode		
Surface treatment	Anti-glare		

4. Mechanical Drawing of Display Module



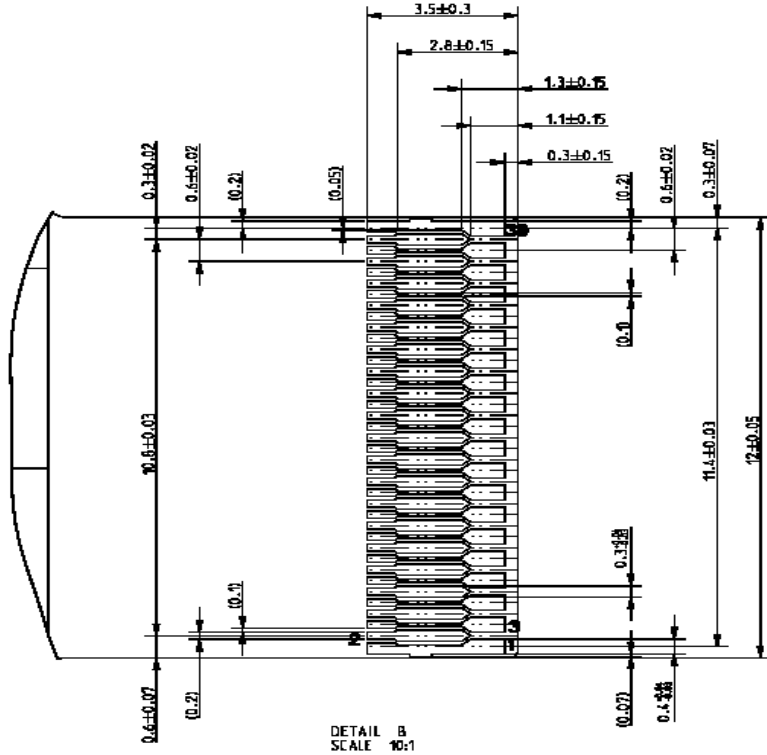
**5. Input / Output Interface**

**5-1) Pin Assignment**

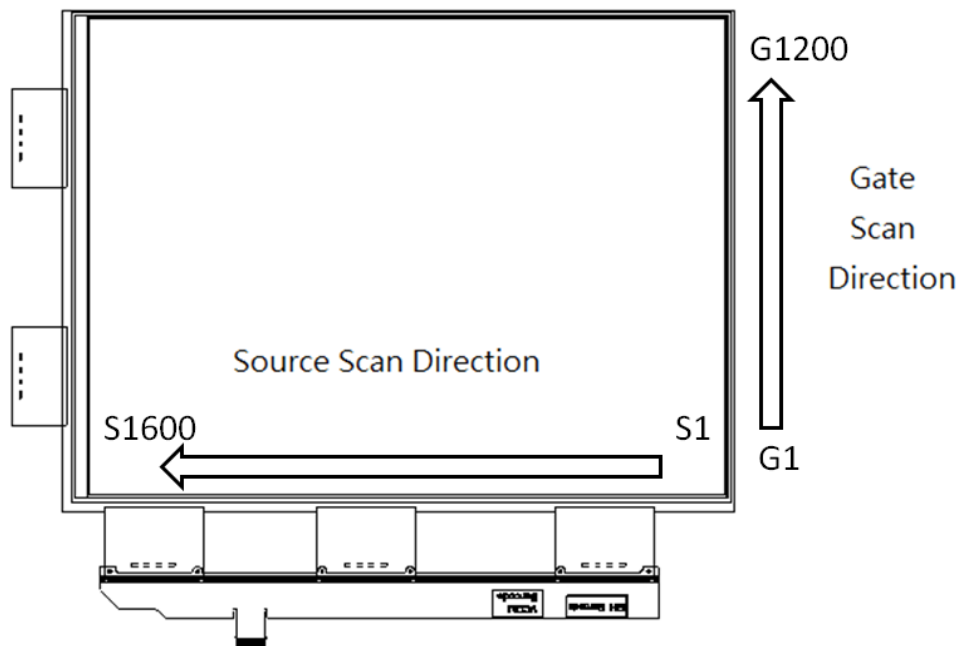
Pin	Signal	Description	Remark
1	VNEG	Negative power supply source driver	
2	VPOS	Positive power supply source driver	
3	VSS	Ground	
4	VDD	Digital power supply drivers	
5	XCL	Clock source driver	
6	XLE	Latch enable source driver	
7	XOE	Output enable source driver	
8	VSS	Ground	
9	VSS	Ground	
10	NC	No Connection	
11	XSTL	Start pulse source driver	
12	D0	Data signal source driver	
13	D1	Data signal source driver	
14	D2	Data signal source driver	
15	D3	Data signal source driver	
16	D4	Data signal source driver	
17	D5	Data signal source driver	
18	D6	Data signal source driver	
19	D7	Data signal source driver	
20	VSS	Ground	
21	VCOM_FPL	Common Voltage	
22	VCOM_TFT	Common Voltage	
23	VGH	Positive power supply gate driver	
24	VGL	Negative power supply gate driver	
25	NC	No Connection	
26	NC	No Connection	
27	XON	All the gate pins output mode	
28	MODE	Output mode selection gate driver	
29	VSS	Ground	
30	VSS	Ground	
31	VSS	Ground	
32	SPV	Start pulse gate driver	
33	CKV	Clock gate driver	
34	BORDER	Border connection	
35	VSS	Ground	
36	VSS	Ground	
37	VSS	Ground	
38	VSS	Ground	
39	VSS	Ground	

5-2) Panels Electrical Connection

SERVICE	CONNECTOR	TYPE NUMBER	NUMBER OF PINS	MATING CONNECTOR
Interface	JST	39FXL-RSM1-S-H-TB	39	Copper foil 0.3mm pitch



5-3) Panel Scan Directions





## 6. Display Module Electrical Characteristics

### 6-1) Absolute maximum rating

Parameter	Symbol	Rating	Unit
Logic Supply Voltage	VDD	-0.3 to +7	V
Positive Supply Voltage	V <sub>POS</sub>	-0.3 to +18	V
Negative Supply Voltage	V <sub>NEG</sub>	+0.3 to -18	V
Max .Drive Voltage Range	V <sub>POS</sub> - V <sub>NEG</sub>	36	V
Supply Voltage	VGH	-0.3 to +55	V
Supply Voltage	VGL	-32 to +0.3	V
Supply Range	VGH-VGL	-0.3 to +55	V
Operating Temp. Range	TOTR	+15 to +35	°C
Storage Temperature	TSTG	-25 to +50	°C

#### Note

- Maximum ratings are those values beyond which damages to the device may occur.
- Functional operation should be restricted to the limits in the Electrical Characteristics chapter.
- **The recommended operating temperature should be kept from 15°C to 35°C**

### 6-2) Panel DC characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Signal ground	VSS			0		V
Logic voltage supply	VDD		2.7	3.3	3.6	V
	IDD	VDD=3.3V		8.5	12.5	mA
Gate negative supply	VGL		-22	-20	-19	V
	IGL	VGL=-20V		10	120	mA
Gate Positive supply	VGH		26	27	29	V
	IGH	VGH=27V		6	12	mA
Source negative supply	VNEG*		-16	Adjusted	-9	V
	INEG	VNEG=-15V		12	50	mA
Source Positive supply	VPOS*		6	Adjusted	17	V
	IPOS	VPOS=15V		15	75	mA
Border supply	(Vcom_FPL)*		(-19)	(Adjusted)	(16)	V
Asymmetry source	Vasm	VPOS+VNEG	-300		300	mV
Common voltage	Vcom_TFT*		-19	Adjusted	16	V
	Icom_TFT			15	120	mA
	Vcom_FPL*		-19	Adjusted	16	V
	Icom_FPL			6	6	mA
Maximum Power panel	Pmax				1500	mW
Typical power panel	Ptyp			500		mW
Standby power panel	Pstby				30	mW

#### Note

- Voltage adjusted by WFM setting.
- Border should be available controlled by WFM setting or floating.

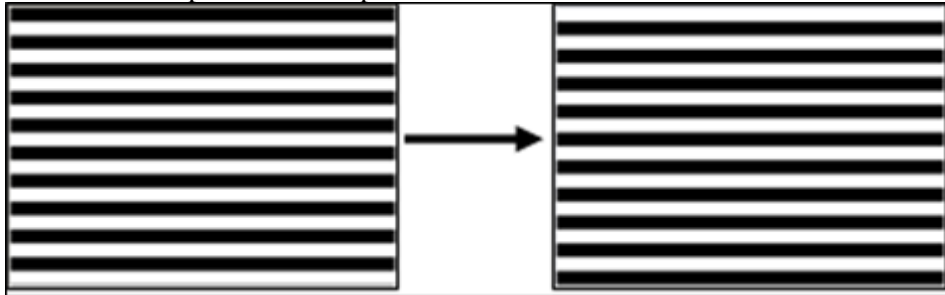
Rush current	IDD	VDD=3.3V	-100		100	mA
	IGL	VGL=-20V	-800		800	mA
	IGH	VGH=27V	-400		400	mA
	INEG	VNEG=-15V	-600			mA
	IPOS	VPOS=15V			1500	mA
	Icom			-1600		1600

Note

- The Maximum power consumption is measured with following pattern transition: from LineA to LineB. (Note 6-1)
- The Typical power consumption is measured with following pattern transition: from horizontal 8 generic color pattern to vertical 8 generic color pattern (Note 6-2)
- VNEG & VPOS should be available controlled by WFM setting.
- Vcom-TFT & Vcom-FPL should be available controlled by WFM setting.
- The standby power is the consumed power when the panel controller is in standby mode.
- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by E Ink.
- Vcom is recommended to be set in the range of assigned value  $\pm 0.1V$ .
- The rush current is for reference only.

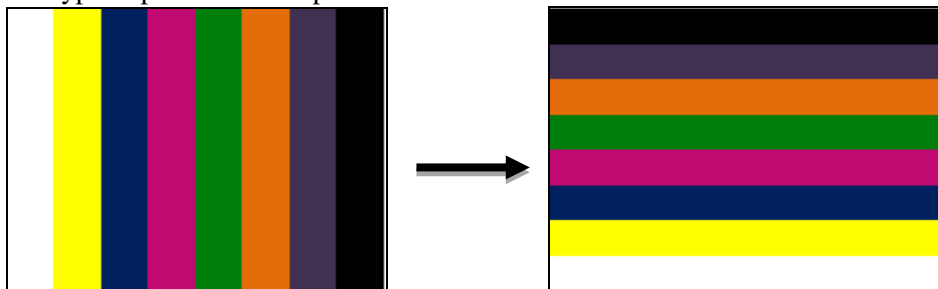
Note 6-1

The Maximum power consumption



Note 6-2

The Typical power consumption



## AA1020-NCA (AC133UT1)

### 6-3) Refresh Rate

The module AC133UT1 is applied at a maximum screen refresh rate of 65Hz.

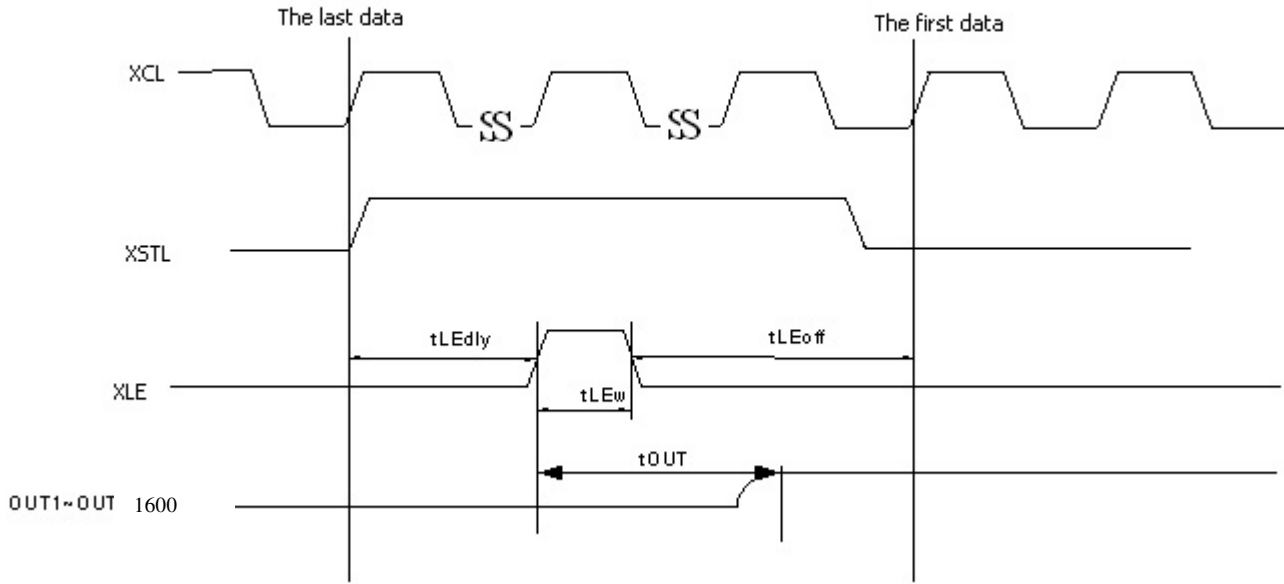
	Min	Max
<b>Refresh Rate</b>	-	65Hz

### 6-4) Panel AC characteristics

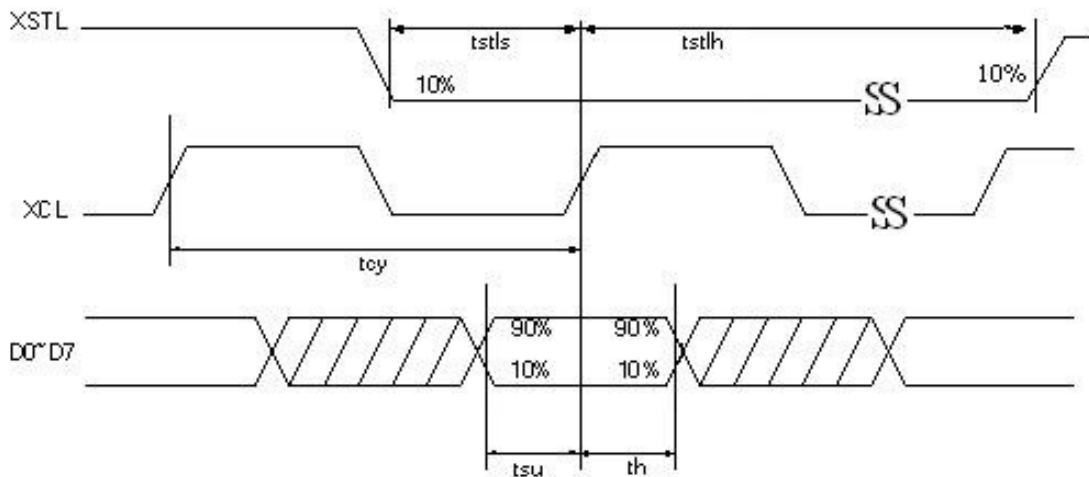
VDD=2.73V to 3.6V, unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock frequency	fckv	-	-	200	kHz
Minimum "L" clock pulse width	twL	0.5	-	-	us
Minimum "H" clock pulse width	twH	0.5	-	-	us
Clock rise time	trckv	-	-	100	ns
Clock fall time	tfckv	-	-	100	ns
SPV setup time	tSU	100	-	twH-100	ns
SPV hold time	tH	100	-	twH-100	ns
Pulse rise time	trspv	-	-	100	ns
Pulse fall time	tfspv	-	-	100	ns
Clock XCL cycle time	tcy	16.7	-	-	ns
D0 .. D7 setup time	tsu	8	-	-	ns
D0 .. D7 hold time	th	8	-	-	ns
XSTL setup time	tstls	8.35	-	-	ns
XSTL hold time	tstlh	8.35	-	-	ns
XLE on delay time	tLEdly	40	-	-	ns
XLE high-level pulse width (When VDD=2.73V to 3.6V)	tLEw	40	-	-	ns
XLE off delay time	tLEoff	200	-	-	ns
Output setting time to +/- 30mV(C <sub>load</sub> =200pF)	tout	-	-	12	us
XON pulse width	twxon	10			us
XON to output delay time	tpd			20	us
Frame Sync Length (Mode 1)	t1	1			1 line

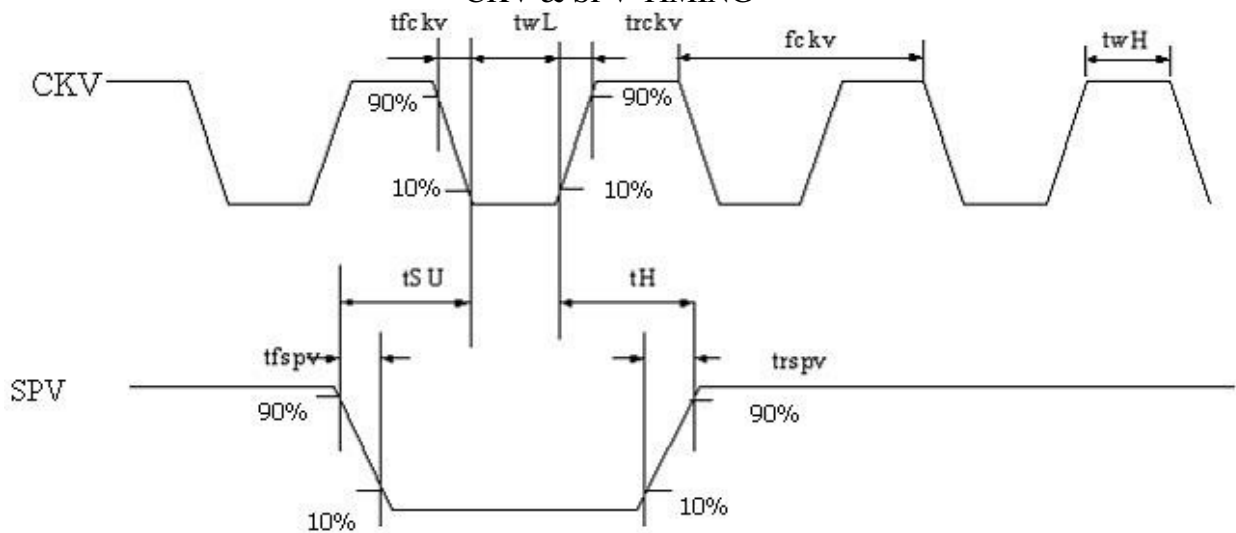
OUTPUT LATCH CONTROL SIGNALS



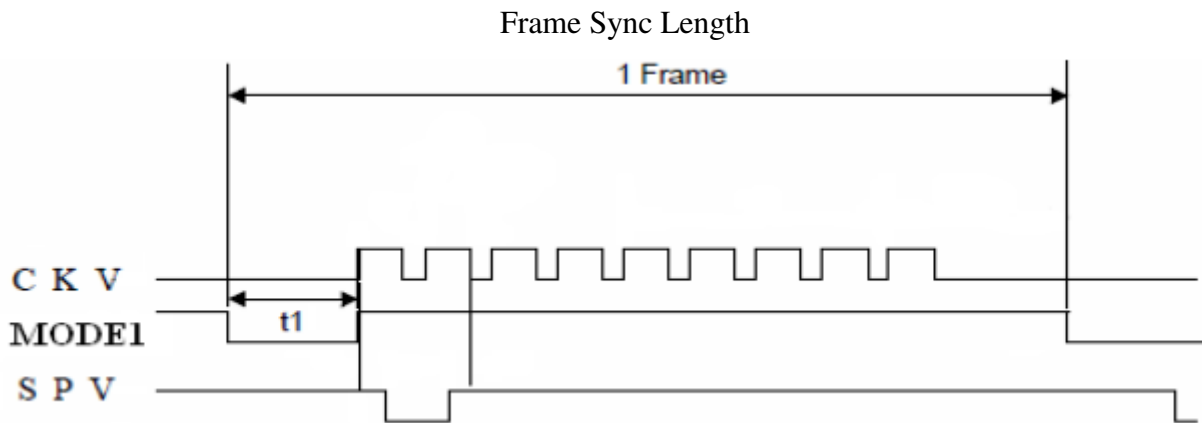
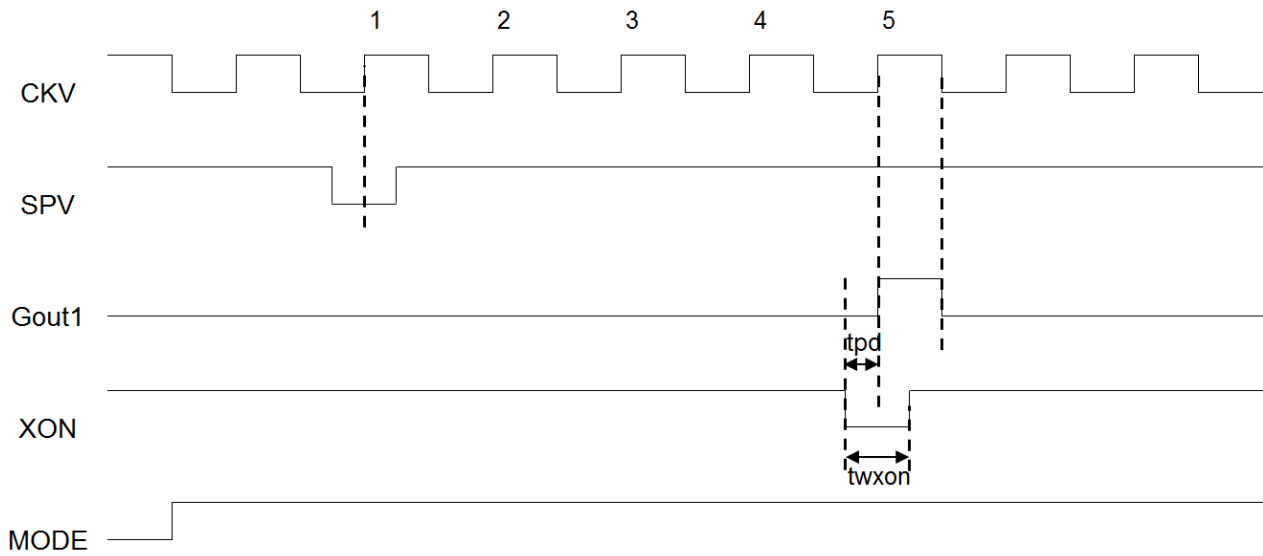
CLOCK & DATA TIMING



CKV & SPV TIMING



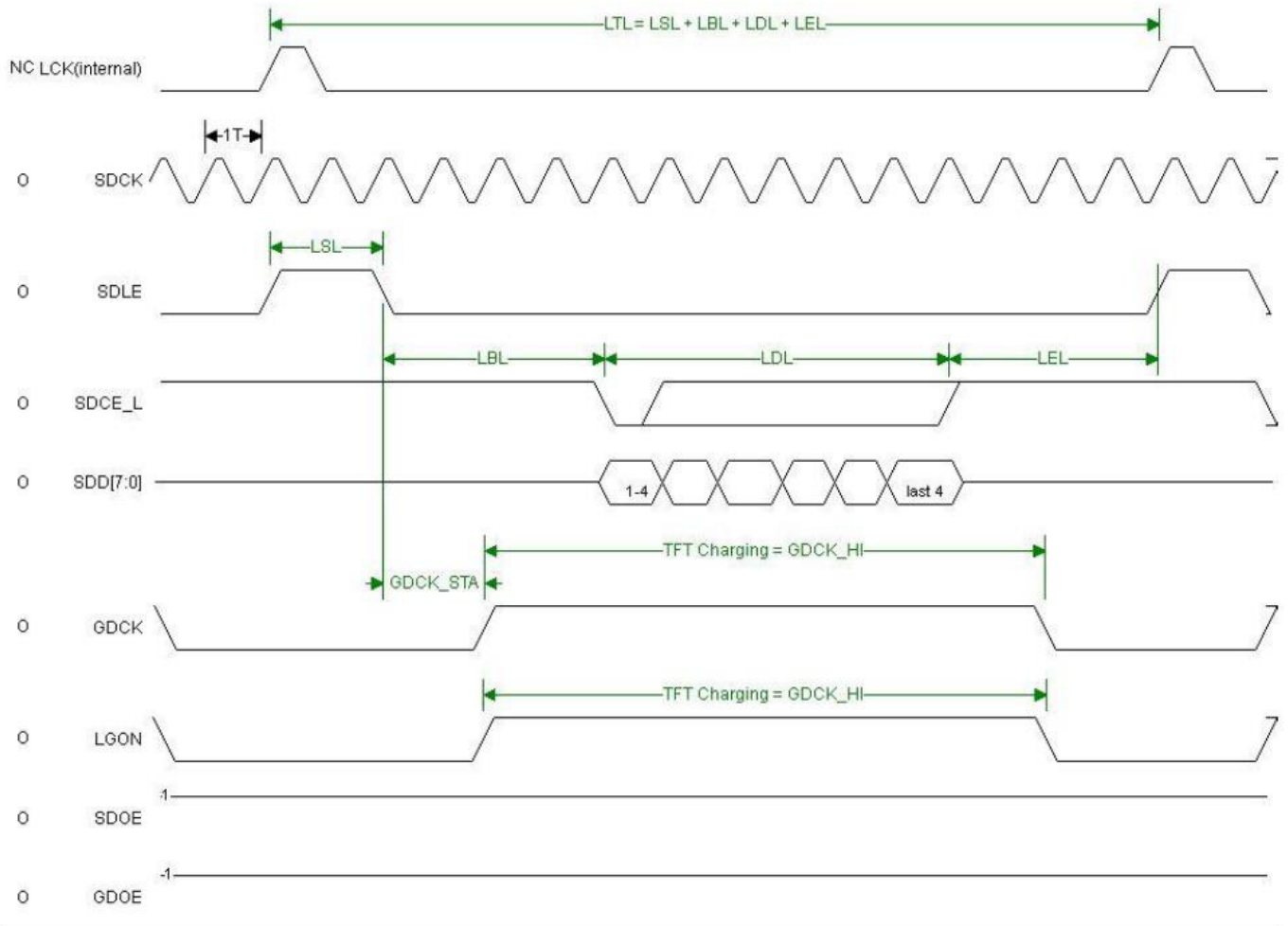
GATE OUTPUT TIMING



Note: First gate line on timing  
After 5CKV, gate line is on.

**6-5) Controllers Timing**

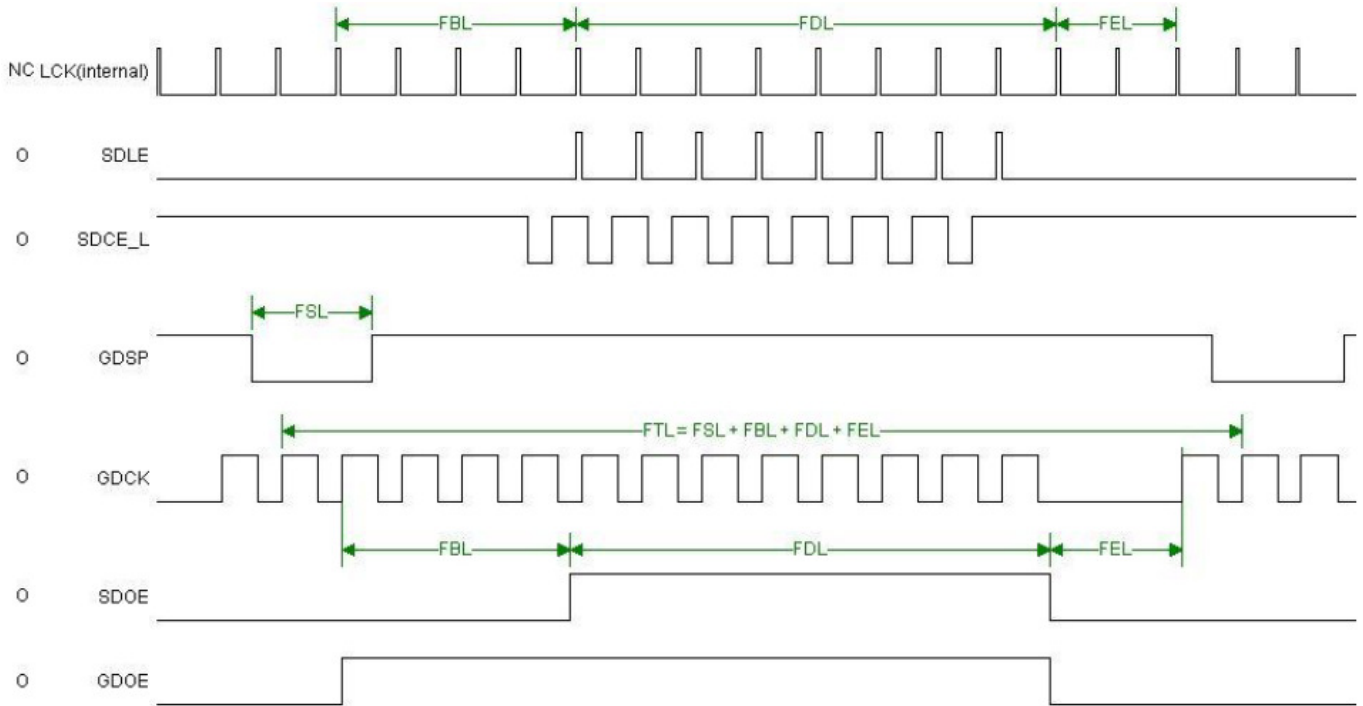
The timing mode is depicted on Figure 1 and Figure 2 and it refers to timing of Source Driver Output Enable (SDOE) and Gate Driver Clock (GDCK). Note, the controller timing in the mode LGON follows GDCK timing.



**Figure 1 Line Timing in Mode 3**

**Note:** LCK is an internal signal and it is shown for reference only.

**AA1020-NCA (AC133UT1)**



**Figure 2 Frame Timing in Mode 3**

**Timing Parameters Table**

<b>Mode</b>	3	<b>Resolution</b>				
<b>SDCK [MHz]</b>	34.29	1600x1200				
<b>Pixels Per SDCK</b>	4					
<b>Line Parameters[SDCK]</b>	<b>LSL</b>	<b>LBL</b>	<b>LDL</b>	<b>LEL</b>	<b>GDCK_STA</b>	<b>LGONL</b>
	6	8	400	20	10	380
<b>Line Parameters[us]</b>	-	-	-	-	-	-
	0.18	0.23	11.67	0.58	0.29	11.08
<b>Frame Parameters [lines]</b>	<b>FSL</b>	<b>FBL</b>	<b>FDL</b>	<b>FEL</b>	-	<b>FR [Hz]</b>
	1	4	1200	10	-	65.02
<b>Frame Parameters [us]</b>	-	-	-	-	-	-
	12.66	50.63	15190	126.58	-	-

Note 1: For Freescale SoC GDOE Low pulse represent FSL and GDSP pulses with the first period of FBL

Note 2:

SDCLK = XCL

SDD[7:0] = D0~D7

SDCE\_L = XSTL

GDCK = CKV

GDSP = SPV

GDOE = Mode1

SDOE = XOE

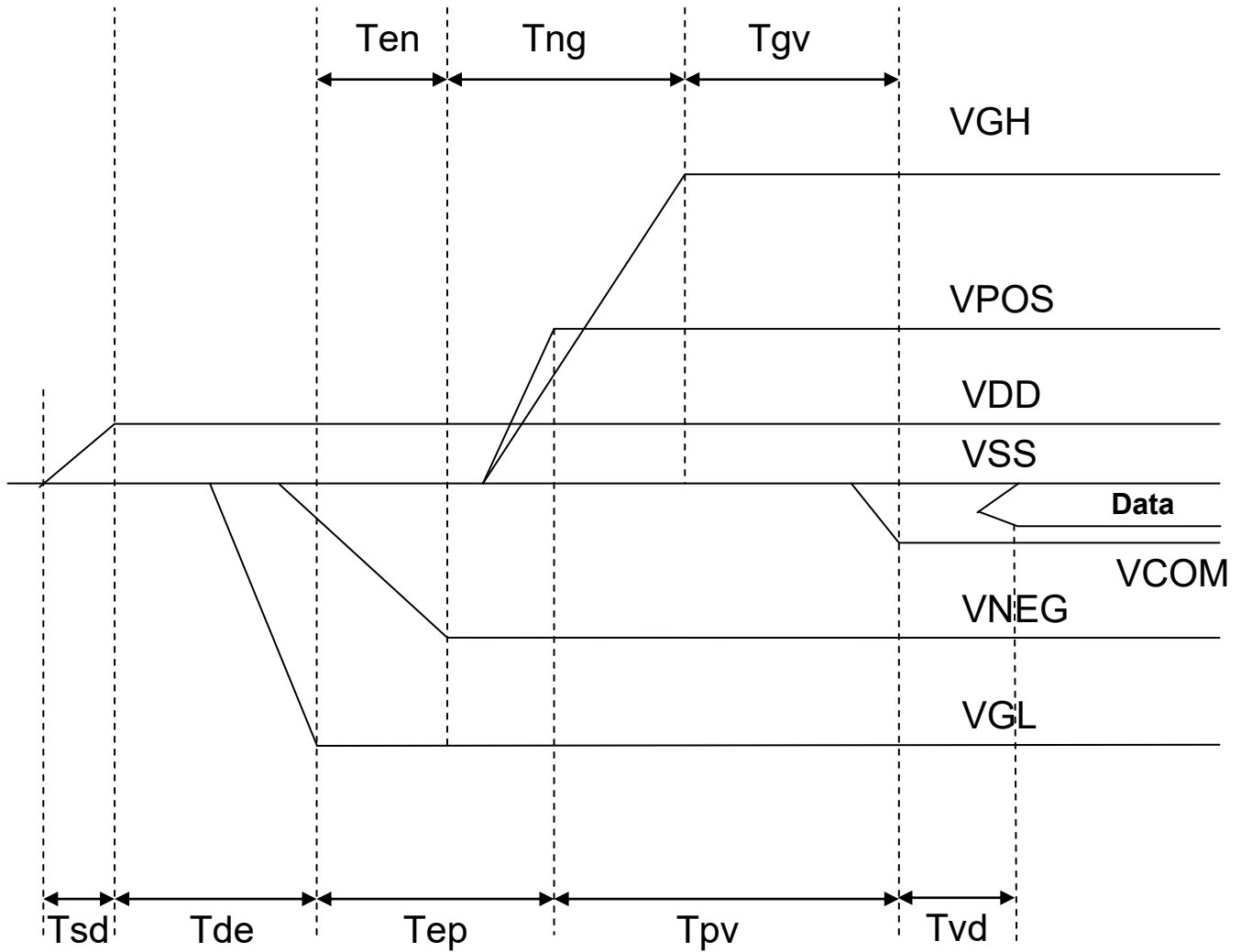
**7. Power Sequence**

Power Rails must be sequenced in the following order :

1. VSS → VDD → VNEG → VPOS (Source driver) → VCOM

2. VSS → VDD → VGL → VGH (Gate driver)

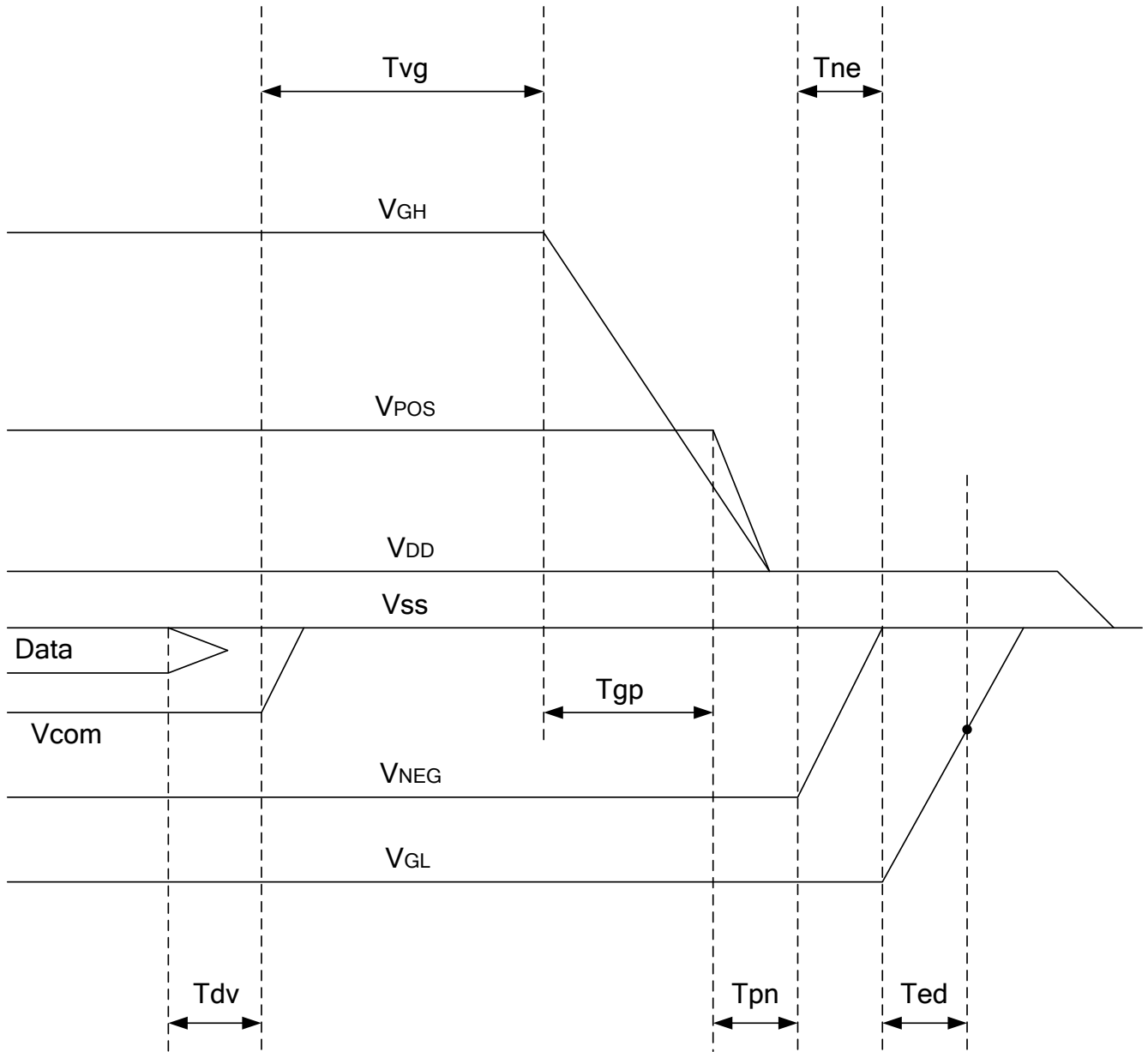
**POWER ON**



	Min	Max
Tsd	30us	-
Tde	100us	-
Tep	1000us	-
Tpv	100us	-
Tvd	100us	-
Ten	0us	-
Tng	1000us	-
Tgv	100us	-



**POWER OFF**



	Min	Max	Remark
Tdv	100μs	-	-
Tvg	0μs	-	-
Tgp	0μs	-	-
Tpn	0μs	-	-
Tne	0μs	-	-
Ted	0.5s	-	Discharged point @ -7.4 Volt

**8. Optical characteristics**

**8-1) Specification**

Measurements are made with that the illumination is under an angle of 45 degrees, the detector is perpendicular unless otherwise specified.

**T = 25°C**

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT	Note
R	Reflectance	White		35	-	%	Note 8-1
CR	Contrast Ratio	-	8	10	-		-
Gamut	Color Saturation	-	50K	60K		dE^3	
Rendered Color	Color Performance	Cyan (0,131,163)		(51.3, -6.3, -4.7)		L*,a*,b*	Note 8-2 8-3
		Magenta (196,0,137)		(45.1, 32.2, -6.4)			
		Yellow (216,203,0)		(65.1, -9.1, 43)			
		Red (190,26,0)		(45.2, 24.5, 21.5)			
		Green (0,137,39)		(54.9, -16.4, 15.5)			
		Blue (59,0,137)		(33.9, 15.5, -23)			
		Black (0,0,0)		(22.7, 6.3, 1.3)			
		White (255,255,255)		(70.5, -1.3, 3.5)			
		Color Variation	dE <sub>2000</sub>			10	dE
T <sub>update_RS</sub>	Update time	Clean mode → image		36		sec	Note 8-4

Note 8-1 : Luminance meter : Eye – One Pro Spectrophotometer

Note 8-2 : The rendered color inputs are chosen to illustrate the color capability of the reflective ACeP display

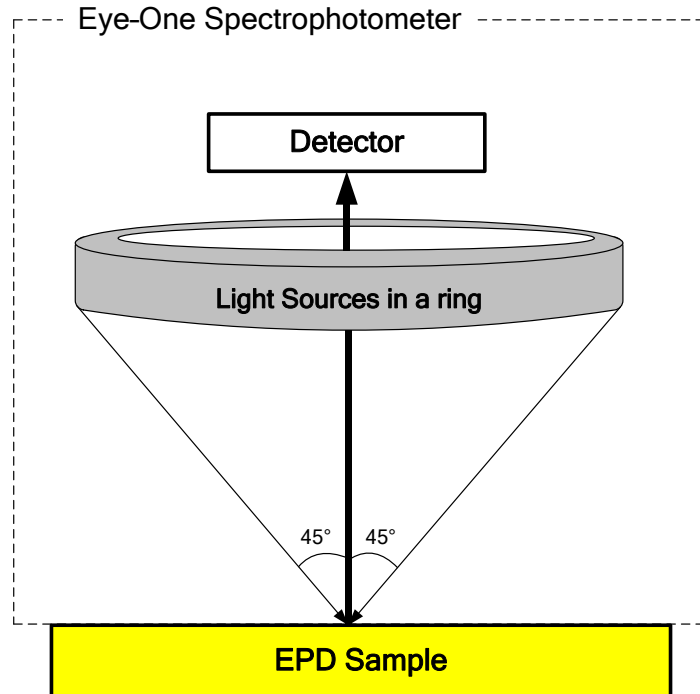
Note 8-3 : 8 rendered color performance values at 25.5 °C ambient; Color meter – PR655 Spectroradiometer

Note 8-4 : Pattern switch : Clean mode (White) → Picture; not include dwell time

**8-2) Definition of contrast ratio**

The contrast ratio (CR) is the ratio between the reflectance in a full white area (Rl) and the reflectance in a dark area (Rd) :

$$CR = Rl/Rd$$



**8-3) Reflection Ratio**

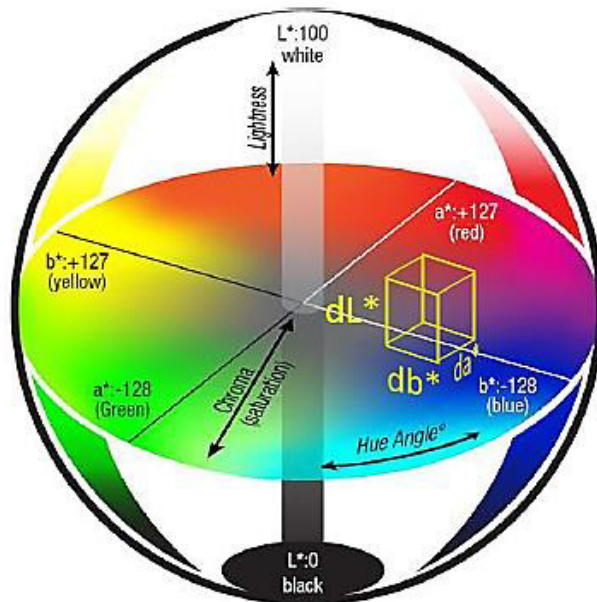
The reflection ratio is expressed as :

$$R = \text{Reflectance Factor}_{\text{white board}} \times (L_{\text{center}} / L_{\text{white board}})$$

$L_{\text{center}}$  is the luminance measured at center in a white area ( $R=G=B=1$ ).  $L_{\text{white board}}$  is the luminance of a standard white board. Both are measured with equivalent illumination source. The viewing angle shall be no more than 2 degrees.

**8-4) Definition of Color Performance**

The Spectroradiometer PR655 with MS-75 lens was used to measure color image to obtain  $L^*$ ,  $a^*$ ,  $b^*$ . Collect  $L^*$ ,  $a^*$ ,  $b^*$  and then determine the color space.



The color difference is expressed as  $dE^*$  distance. ACeP module uses  $dE_{2000}$  for calculation.

**9.HANDLING, SAFETY AND ENVIROMENTAL REQUIREMENTS**

**WARNING**

The display may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, do not touch the electrophoretic material. In case of contact with electrophoretic material, wash with water and soap.

**CAUTION**

The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components.

Disassembling the display module can cause permanent damage and invalidate the warranty agreements.

IPA solvent can only be applied on active area and the back of a glass. For the rest part, it is not allowed

**Mounting Precautions**

(1) It's recommended that you consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.

(2) It's recommended that you attach a transparent protective plate to the surface in order to protect the EPD. Transparent protective plate should have sufficient strength in order to resist external force.

(3) You should adopt radiation structure to satisfy the temperature specification.

4) Acetic acid type and chlorine type materials for the cover case are not desirable because he former generates corrosive gas of attacking the PS at high temperature and the latter cause's circuit break by electro-chemical reaction.

(5) Do not touch, push or rub the exposed PS with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of PS for bare hand or greasy cloth. (Some cosmetics deteriorate the PS)

(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach the PS. Do not use acetone, toluene and alcohol because they cause chemical damage to the PS.

(7) Wipe off saliva or water drops as soon as possible. Their long time contact with PS causes deformations and color fading.

**Data sheet status**

Product specification

This data sheet contains Preliminary product specifications.

**Limiting values**

Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other condition These are stress ratings only and operation of the device at these or at any other condition to limiting values for extended periods may affect device reliability.

**Application information**

Where application information is given, it is advisory and does not form part of the specification

**10. Reliability test**

	TEST	CONDITION	METHOD	REMARK
1	High-Temperature Operation	T = +35°C, RH = 50% for 240 hrs	IEC 60 068-2-2Bp	--
2	Low-Temperature Operation	T = 15°C, RH = 35% for 240 hrs	IEC 60 068-2-2Ab	--
3	Low-Temperature Storage	T = -25°C for 240 hrs Test in white pattern	IEC 60 068-2-1Ab	--
4	High-Temperature Storage	T = +50°C, RH = 30% for 240 hrs	IEC 60 068-2-2Bp	
5	High-Temperature, High-Humidity Storage	T = +50°C, RH = 80% for 240 hrs	IEC 60 068-2-3CA	
6	Temperature Cycle	-25°C→+60°C,, 50 Cycles 30min 30min Test in white pattern	IEC 60 068-2-14	--
7	Package Vibration	1.04G, Frequency: 10~500Hz Direction: X,Y,Z Duration: 1 hours in each direction	Full packed for shipment	--
8	Package Drop Impact	Drop from height of 122 cm on concrete surface. Drop sequence: 1 corner,3 edges,6 faces One drop for each.	Full packed for shipment	--
9	Electrostatic Effect (non-operating)	(Machine model)+/- 250V 0Ω, 200pF	IEC 62179, IEC 62180	--

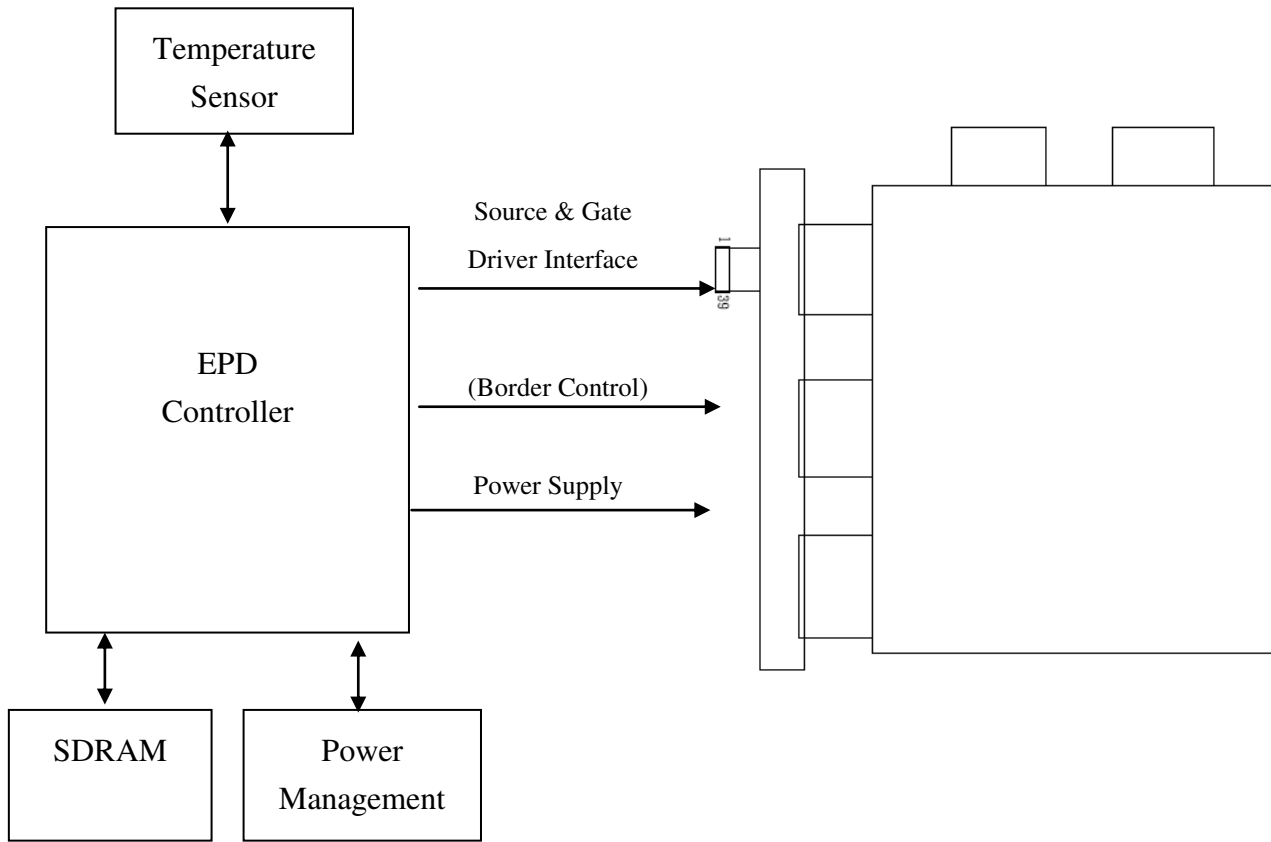
Actual EMC level to be measured on customer application

Note: The protective film must be removed before temperature test.

< Criteria >

In the standard conditions, there is not display function NG issue occurred. (including : line defect ,no image). All the cosmetic specification is judged before the reliability stress.

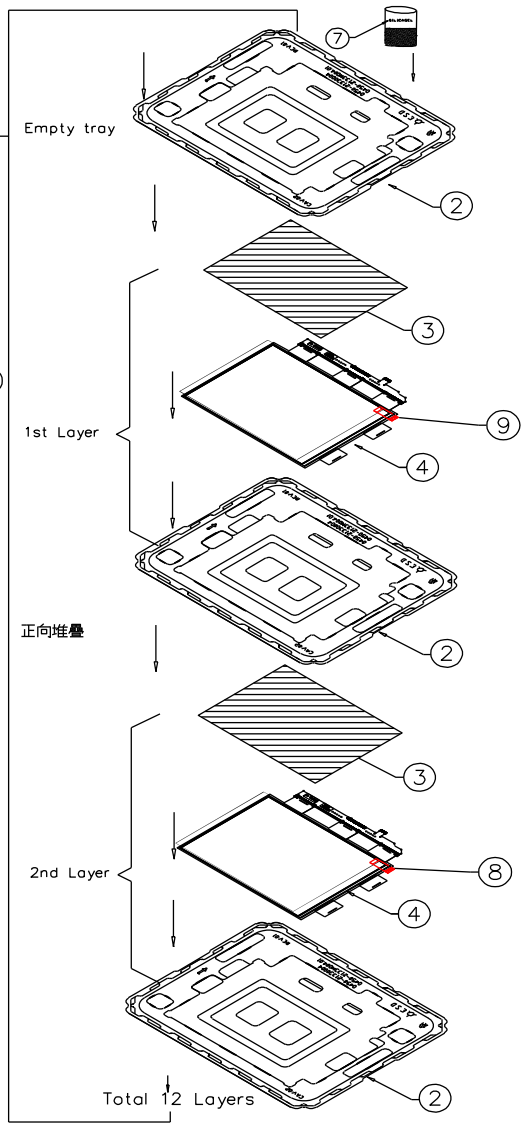
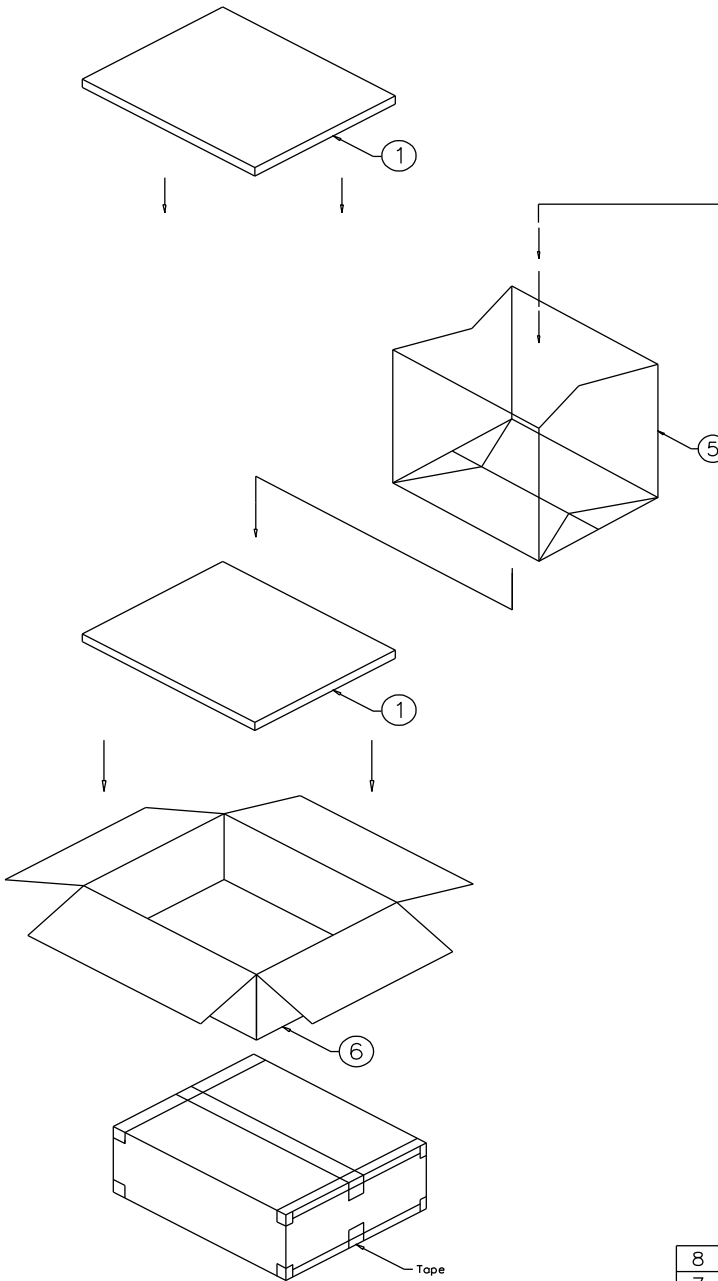
11. Block Diagram





12. Packing

REV	DESCRIPTION	DESIGN	DATE
01	INITIAL RELEASE	Jerry Lin	20181210



**NOTE:**

- 1. One layer include: 1 piece of cushion sheet, 1 pcs panel & 1 piece of tray.
- 2. QTY: 12 pcs panel/carton.
- 3. Dimension: 455\*375\*190mm
- 4. Weight: 5.0 KG

8	EASY TAPE	12	For Remove Protect Sheet
7	30g 加厚复合气泡缓冲垫(规格:73*95mm(料号:K0030))	2	
6	CARTON INTERNAL	1	
5	摺口袋450*380*700mm	1	抗靜電
4	E-D133UT2	12	
3	EPE CUSHION SHEET	12	抗靜電
2	PET TRAY	13	抗靜電
1	EPE FOAM	2	
ITEM	DESCRIPTION	QTY	REMARK

MTL.SPEC.		UNSPECIFIED TOL'S		REMARK	
		ANGLE			
		ROUGHNESS			
APPROVE	Chih-Chia	SCALE	UNIT	SHEET	DWG.TITLE
CHECK	Chih-Chia	1:1	mm	1 OF 1	AC133UT1 PACKING
DESIGN	Jerry Lin	MTL.NO.		DWG.NO.	A4 SIZE



### 13. Bar Code definition

Type1 Early FPL platform's barcode

<u>C01</u>	<u>R4</u>	<u>A</u>	<u>09</u>	<u>1</u>	<u>U</u>	<u>A</u>	<u>V</u>	<u>0007N</u>	<u>AT</u>
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>5</u>	<u>6</u>	<u>2</u>	<u>7</u>	<u>2</u>

1 : EPD model code

2 : Internal control codes

3 : FPL lot codes

4 : FPL lot codes

5 : Year:

U: 2019 / V: 2020 / W: 2021 /... / Z: 2024

6 : Month:

1:Jan. 2:Feb. ... 9:Sep. A:Oct. B:Nov. C:Dec.

7 : Serial codes

Type2 New FPL platform's barcode

<u>C01</u>	<u>R4</u>	<u>AAA</u>	<u>017</u>	<u>1</u>	<u>V</u>	<u>9</u>	<u>T</u>	<u>0000G</u>	<u>AT</u>
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>2</u>	<u>5</u>	<u>6</u>	<u>2</u>	<u>7</u>	<u>2</u>

1 : EPD model code

2 : Internal control codes

3 : FPL lot codes

4 : FPL lot codes

5 : Year:

U: 2019 / V: 2020 / W: 2021 /... / Z: 2024

6 : Month:

1:Jan. 2:Feb. ... 9:Sep. A:Oct. B:Nov. C:Dec.

7 : Serial codes

# DATA MODUL



ALL TECHNOLOGIES. ALL COMPETENCIES. ONE SPECIALIST.



**DATA MODUL AG**  
Landsberger Straße 322  
DE-80687 Munich  
Phone: +49 89 56017 0

**DATA MODUL WEIKERSHEIM GMBH**  
Lindenstraße 8  
DE-97990 Weikersheim  
Phone: +49 7934 101 0

