POWERTIP TECH. CORP.

DISPLAY DEVICES FOR BETTER ELECTRONIC DESIGN

Specification For Approval

Customer : _____

Model Type : LCD MODULE

Sample Code : _____

Mass Production Code : PG24064WRU-AYA-HL1

Revision : 0

Customer Sign	Sales Sign	Checked By (QA)	Approved By	Prepared By

Revision Record

Date(y/m/d)	Rev.	Description	Note	Page
2003/01/30	0			

Contents

1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	240*64 Dots
LCD Type	FSTN, Transflective, Positive, Extended Temp.
Driver Type	1/64 Duty , 1/9 Bias
Viewing Direction	6 O'clock
Backlight	LED Backlight
Weight	-
Other	—

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	180.0 (L) * 65.0 (w) * 9.1 (H)(Max)	mm
Viewing Area	134.0 (L) * 40.4 (w)	mm
Active Area	127.16 (L) * 33.38 (w)	mm
Dot Size	0.49 (L) * 0.49 (w)	mm
Dot Pitch	0.53 (L) * 0.53 (w)	mm

1.3 Absolute Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Power supply Voltage	V_{DD}	-	-0.3	7.0	V
LCD drive Supply voltage	V_{DD}-V_{EE}	-	V_{DD}+0.3	20	V
Input voltage	V_{IN}	-	-0.3	V_{DD}+0.3	V
Operating temperature	T_{OPR}	-	-20	70	°C
Storage temperature	T_{STG}	-	-30	80	°C
Humidity	HD	-	-	90	%RH

1.4 DC Electrical Characteristics

V_{DD}=+5V±10%,V_{SS}=0V,TA=25°C

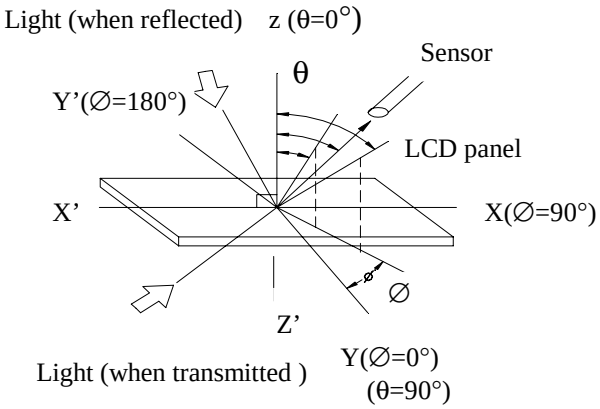
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply voltage	V_{DD}	-	4.75	-	5.25	V
“H” input voltage	V_{IH}	-	2.2	-	V_{DD}	V
“L” input voltage	V_{IL}	-	0	-	0.8	V
“H” output voltage	V_{OH}	-	2.4	-	V_{DD}	V
“L” output voltage	V_{OL}	-	0	-	0.4	V
Supply current	I_{DD}	-	-	36.7	44.4	mA
LCD driving voltage	V_{OP}	VDD-VO	-	10.2	12.0	V

1.5 Optical Characteristics

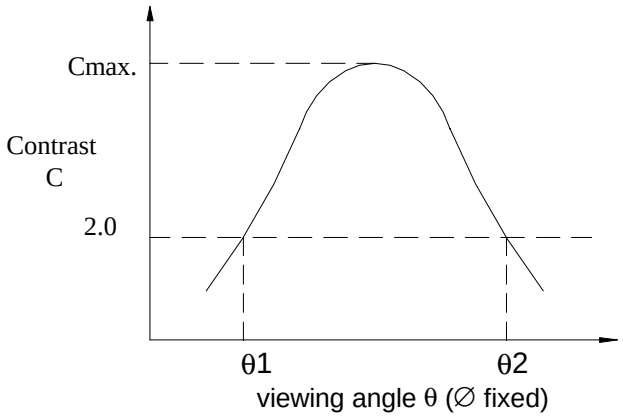
1/64 duty, 1/9 bias, V_{OPR}=12.7V, Ta=25°C

Item	Symbol	Conditions	Min.	Typ.	Max	Reference
Viewing angle	θ	C≥2.0,∅=0°	30°	-	-	Notes 1 & 2
Contrast	C	θ=5°, ∅=0°	-	3	-	Note 3
Response time(rise)	T_r	θ=5°, ∅=0°	-	140ms	200ms	Note 4
Response time(fall)	T_f	θ=5°, ∅=0°	-	300ms	500ms	Note 4

Note 1: Definition of angles θ and ∅



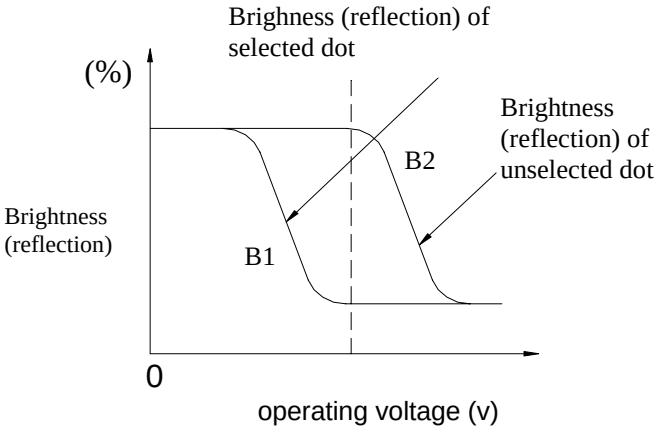
Note 2: Definition of viewing angles θ1 and θ2



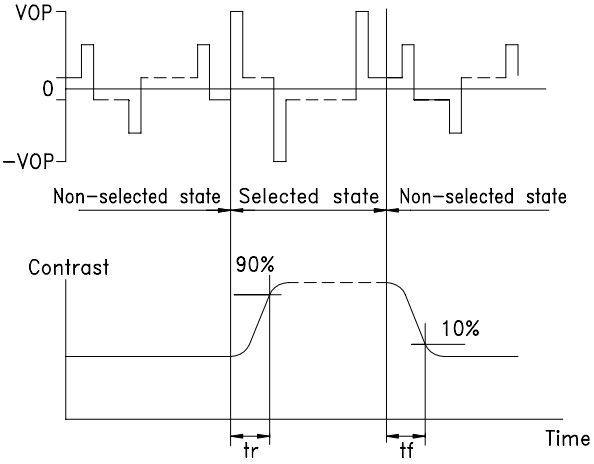
Note : Optimum viewing angle with the naked eye and viewing angle θ at Cmax. Above are not always the same

Note 3: Definition of contrast C

$$C = \frac{\text{Brightness (reflection) of unselected dot (B2)}}{\text{Brightness (reflection) of selected dot (B1)}}$$



Note 4: Definition of response time



Note: Measured with a transmissive LCD panel which is displayed 1 cm^2

V_{OPR} : Operating voltage
f_{FRM} : Frame frequency
t_r : Response time (rise)
t_f : Response time (fall)

1.6 Backlight Characteristics

LCD Module with LED Backlight

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward current	I_F	T_A=25°C	-	100	mA
Reverse voltage	V_R	T_A=25°C	-	5	V
Power dissipation	P_O	T_A=25°C	-	0.3	W
Operating Temperature	T_{OPR}	-	-20	70	°C
Storage temperature	T_{STG}	-	-40	80	°C

•.Electrical \ Optical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_F	I_F=80mA	-	3.3	3.8	V
Reverse current	I_R	V_R=5V	-	-	10	μA
Luminous intensity	I_V	I_F=80mA	-	60	-	cd/m^2
Chromaticity Coordinates	X	IF=80mA	-	0.28	-	
	Y	IF=80mA	-	0.29	-	
Color	White					

2. MODULE STRUCTURE

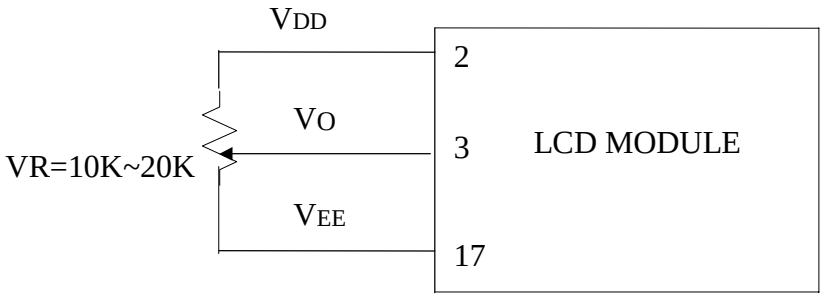
2.1 Counter Drawing

* See Appendix

2.2 Interface Pin Description

Pin No.	Symbol	Function
1	V_{SS}	Power Supply (Vss=0)
2	V_{DD}	Power Supply (V_{DD}>V_{SS})
3	V_O	Operating voltage for LCD
4	RS	Register selection input High = Data register Low = Instruction register (for write) Busy flag address counter (for read)
5	$\overline{R/W}$	$\overline{R/W}$ signal input is used to select the read/write mode High = Read mode, Low = Write mode
6	E	Start enable signal to read or write the data
7-14	DB0~DB7	Data bus
15	CS	Chip select Active low
16	$\overline{RESET}$	Controller reset (module reset)
17	V_{EE}	Negative voltage power supply –10V
18	NC	Not connection
19	A	Power supply for LED B/L (+)
20	K	Power supply for LED B/L (-)

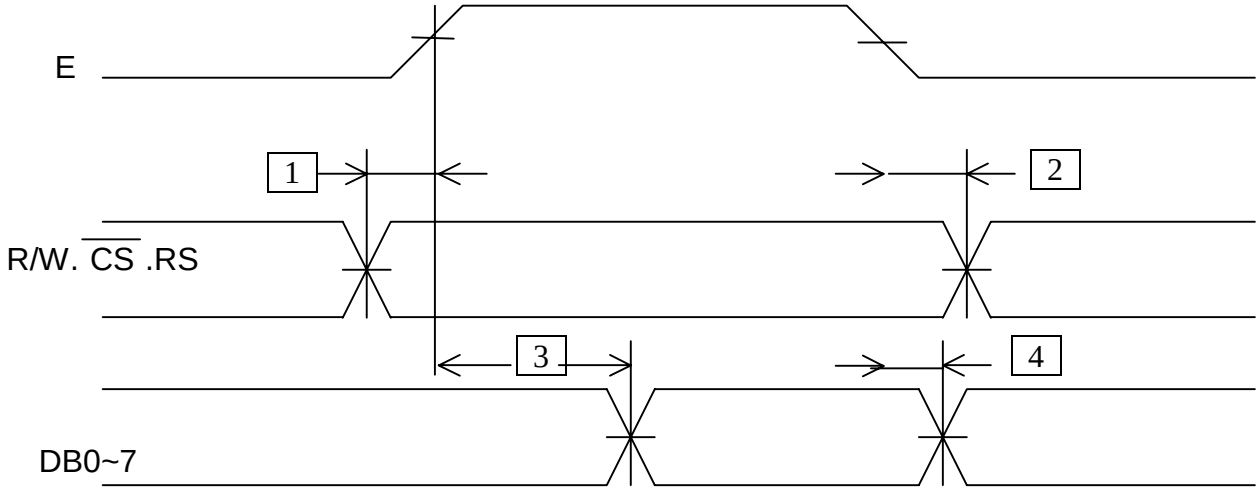
Contrast Adjust



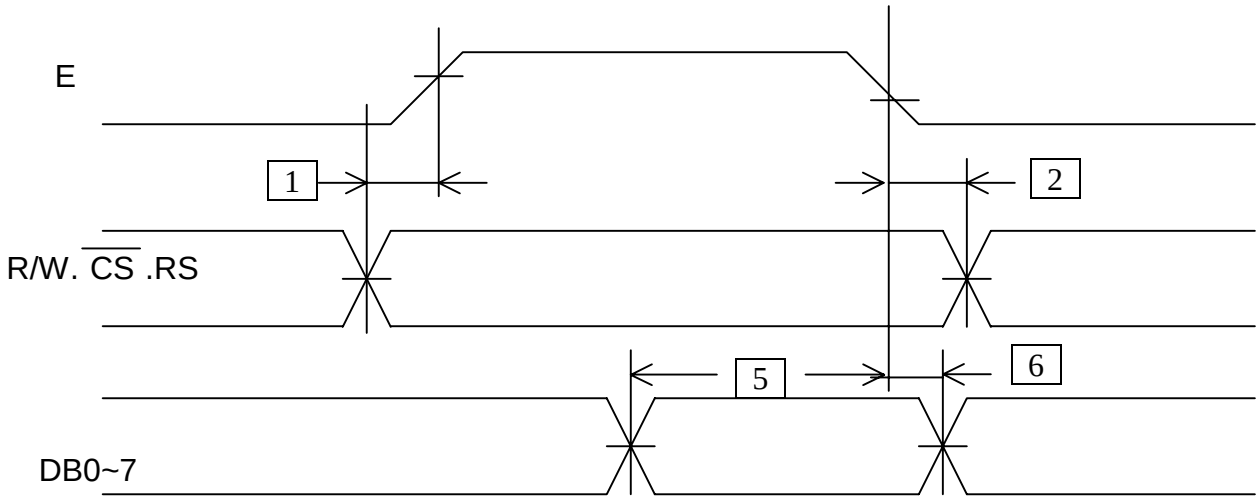
2.3 Timing Characteristics

- Bus read/write timing

Read cycle



Write cycle



TA=-20 to +75ºC, V_{DD}= 5V±5%, GND= 0V

No	Item	Symbol	Min.	typ	Max.	Unit	Conditions
1	Address set-up time	t_{AS}	90	-	-	ns	-
2	Address hold time	t_{AH}	10	-	-	ns	-
3	Data delay time(read)	t_{DDR}	-	-	140	ns	C_L=50pF
4	Data hold time (read)	t_{DHR}	10	-	-	ns	-
5	Data set-up time (write)	t_{DSW}	220	-	-	ns	-
6	Data hold time (write)	t_{DHW}	20	-	-	ns	-

Display command

- Display control instruction

Display is controlled by writing data into the instruction register and 13 data registers. The instruction register and the data register are distinguished by the RS signal. First, write 4-bit data

in the instruction register when RS=1, then specify the code of the data register. Next with RS=0, write 8-bit data in the data register, which executes the specify instruction.

A new instruction cannot be accepted while an old instruction is being executed. As the Busy flag is set under this condition, write an instruction only after reading the Busy flag and making sure that it is 0.

However, the next instruction can be executed without checking the Busy flag when the maximum read cycle time or the write cycle time has been exceeded after execution of the previous data read instruction or the data write instruction. The Busy flag does not change when data is written into the instruction register (RS=1) .Therefore, the Busy flag need not be checked immediately after writing data into the instruction register.

(1)Mode control

Write code “00H” (in hexadecimal notation) in the instruction register and specify the mode control register.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	0	0	0	0
Mode control Reg	0	0	0	0	MODE Data					

DB5	DB4	DB3	DB2	DB1	DB0	Cursor / blink	CG	Graphic/character display
1 / 0	1 / 0	0	0	0	0	Cursor OFF	Built-in CG	Character display
		0	1			Cursor ON		
		1	0			Cursor OFF		
		1	1			Cursor blink		
		0	0		1	Cursor OFF	External CG	
		0	1			Cursor ON		
		1	0			Cursor OFF character blink		
		1	1			Cursor blink		
		0	0	1	0			Graphic mode

Display ON/OFF	Master/slave	Blink	Cursor	Mode	External/ builtin CG
1: display ON 0: display OFF	1: master mode 0: slave mode				

(2)Setting the character pitch

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	0	0	0	1
Character pitch Reg	0	0	(Vp-1) Binary				0	(Hp-1) Binary		

Vp is the number of vertical dots per character. Determine Vp with the pitch between two vertically placed characters taken into consideration. This value is meaningful only in the character display mode: It is invalid in the graphic mode.
In character mode, Hp indicates the number of horizontal dots per character, from the leftmost part of one character to the leftmost part of the next. In the graphic mode, Hp indicates how many bits (or dots) from RAM appear in a 1-byte display.
Hp must take one of the following three values.

Hp	DB2	DB1	DB0	
6	1	0	1	Horizontal character pitch 6
7	1	1	0	Horizontal character pitch 7
8	1	1	1	Horizontal character pitch 8

(3)Setting the number of characters

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	0	0	1	0
Character number Reg	0	0	(H_N -1) Binary (239)							

In the character display mode, H_N indicates the number of characters in the horizontal direction. In the graphic mode, it indicates the number of bytes in the horizontal direction. The total number of dots positioned horizontally on the screen n is given by the formula $n=Hp * H_N$. Even numbers in the range 2 to 256 (decimal) can be set as H_N.

(4) Setting the time division number (display duty)

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	0	0	1	1
Time division Reg	0	0	(Nx -1) Binary (127)							

Consequently, 1/Nx is the display duty.
Decimal numbers within the range 1 to 256 can be set as Nx.

(5)Setting the cursor position

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	0	1	0	0
Cursor position Reg	0	0	0	0	0	0	(Cp - 1) Binary			

In the character display mode, Cp indicates the line at which the cursor is displayed. For example, when Cp=8 (decimal) is specified, the cursor is displayed beneath the character of the 5*7 dot-font. The horizontal length of the cursor equals Hp (the horizontal character pitch). Decimal values in the range 1 to 16 can be assigned to Cp. When the value is less than the vertical character pitch Vp (Cp≤Vp), display priority is given to the cursor (provided the cursor display is ON). The cursor is not displayed when CP) Vp. The horizontal length of the cursor equals Hp.

(6)Setting the display start lower address

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	0	0	0
Mode control Reg	0	0	(start address lower byte) binary							

(7)Setting the display start upper address

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	0	0	1
Display start address Reg (lower byte)	0	0	(start address upper byte) binary							

This instruction writes the display start address value in the display start address register. The display start address at which data to be displayed at the leftmost position of the top line of the screen is stored.
The start address consists of 16 bit (upper and lower).

(8)Setting the cursor (lower) address (RAM read/write lower address)

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	0	1	0
Cursor address counter (lower byte)	0	0	(cursor address lower byte) binary							

(9)Setting the cursor (upper) address (RAM read/write lower address)

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	0	1	1
Cursor address counter (upper byte)	0	0	(cursor address upper byte) binary							

This instruction writes the cursor address value in the cursor address counter. The cursor address indicates the address for exchanging display data and character codes with RAM. In other words, data at the address specified by the cursor address is read from or written into RAM. In character display, the cursor is displayed at the position specified by the cursor address.The cursor address is divided into a lower address (8 bits) and an upper address (8 bits). It should be set in accordance with the following rules.

1	To rewrite (set) both lower and upper addresses:	First set the lower address, then the upper.
2	To rewrite the lower address:	Always reset the upper address after setting the lower address.
3	To rewrite the upper address only:	Set the upper address. It is necessary to reset the lower address.

The cursor address counter is a 16-bit up-counter with set/reset functions: when the Nth bit goes from 1 to 0, the count of the (N + 1)th bit increments by one. Accordingly, when the lower address is set so that the lower MSB (8th bit) changes from 1 to 0, the LSB (1st bit) of the upper counter must increment by one. When setting the cursor address, set the lower and upper addresses as a 2-byte continuous instruction.

(10)Writing display data

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	1	0	0
RAM	0	0	MSB (pattern data, character code)							LSB

Write code “0DH” in the instruction register. Then, Write 8-bit data with RS=0, and the data is written into RAM as display data or character codes at the address specified by the cursor address counter. After writing, the count of the cursor address counter increments by 1.

(11)Reading display data

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	1	0	1
RAM	1	0	MSB (pattern data, character code)							LSB

Write “0CH” in the instruction register. Then, establish the read status with RS=0, and data in the RAM can be read. The procedure for reading data is as follows:

This instruction outputs the contents of the data output register to DB0 to 7, then transfers the RAM data indicated by the cursor address to the data output register. It then increments the cursor address by 1, which means that correct data cannot be read in the first read operation. The specified value is output in the second read operation. Accordingly, a dummy read operation must be performed once when reading data after setting the cursor address.

(12)Bit clear

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	1	1	0
Bit clear	0	0	0	0	0	0	0	(N_B -1) Binary		

(13)Bit set

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction Reg	0	1	0	0	0	0	1	1	1	1
Bit set	0	0	0	0	0	0	0	(N_B -1) Binary		

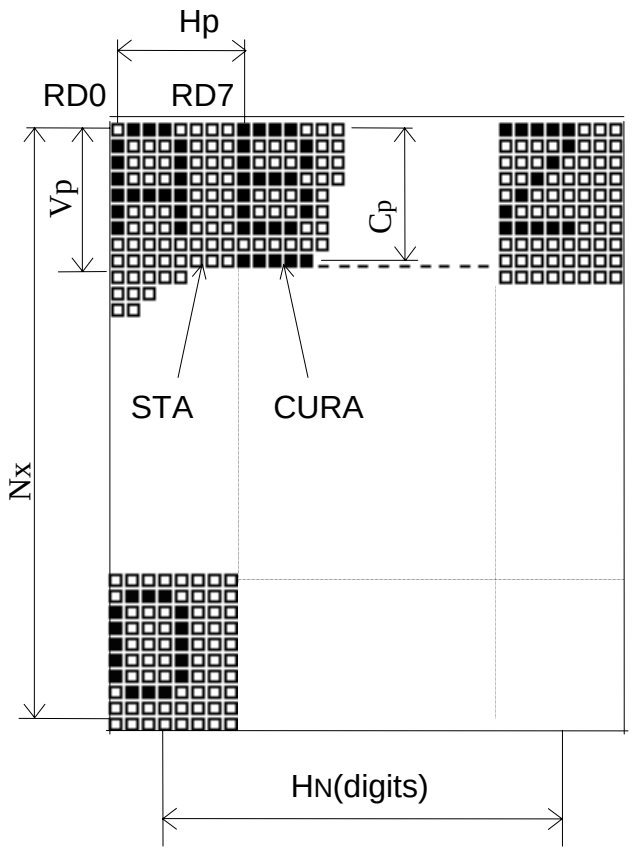
As the bit-clear or bit-set instruction, 1 bit of a 1 byte of data in display RAM is set to 0 or 1. The bit specified by N_B is set to 0 for the bit-clear instruction and 1 for the bit-set instruction. The RAM address is specified by the cursor address, which is automatically incremented by 1 at the completion of the instruction. NB is a value in the range from 1 to 8. The LSB is indicated by N_B=1, and the MSB by N_B=8.

(14)Reading the BUSY flag

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
busy flag	1	1	1/0	*						

The Busy flag is output to DB7 when read mode is established with RS=1. The Busy flag is set to 1 while any of the instructions (1) through (13) is being executed. It is set to 0 at the completion of the execution, allowing the next instruction to be accepted. No other instruction can be accepted when the Busy flag is 1. Accordingly, before writing an instruction and data, it is necessary to ensure that the Busy flag is 0. However, the next instruction can be executed without checking the Busy flag when the maximum read cycle time or the write cycle time has been exceeded after execution of the previous data read instruction or the data write instruction.
The Busy flag does not change when data is written into the instruction register (RS=1). Therefore, the Busy Specification of the instruction register is unnecessary to read the Busy flag.

The relation between the LCD panel display and Hp, H_N, Vp, Cp, Nx

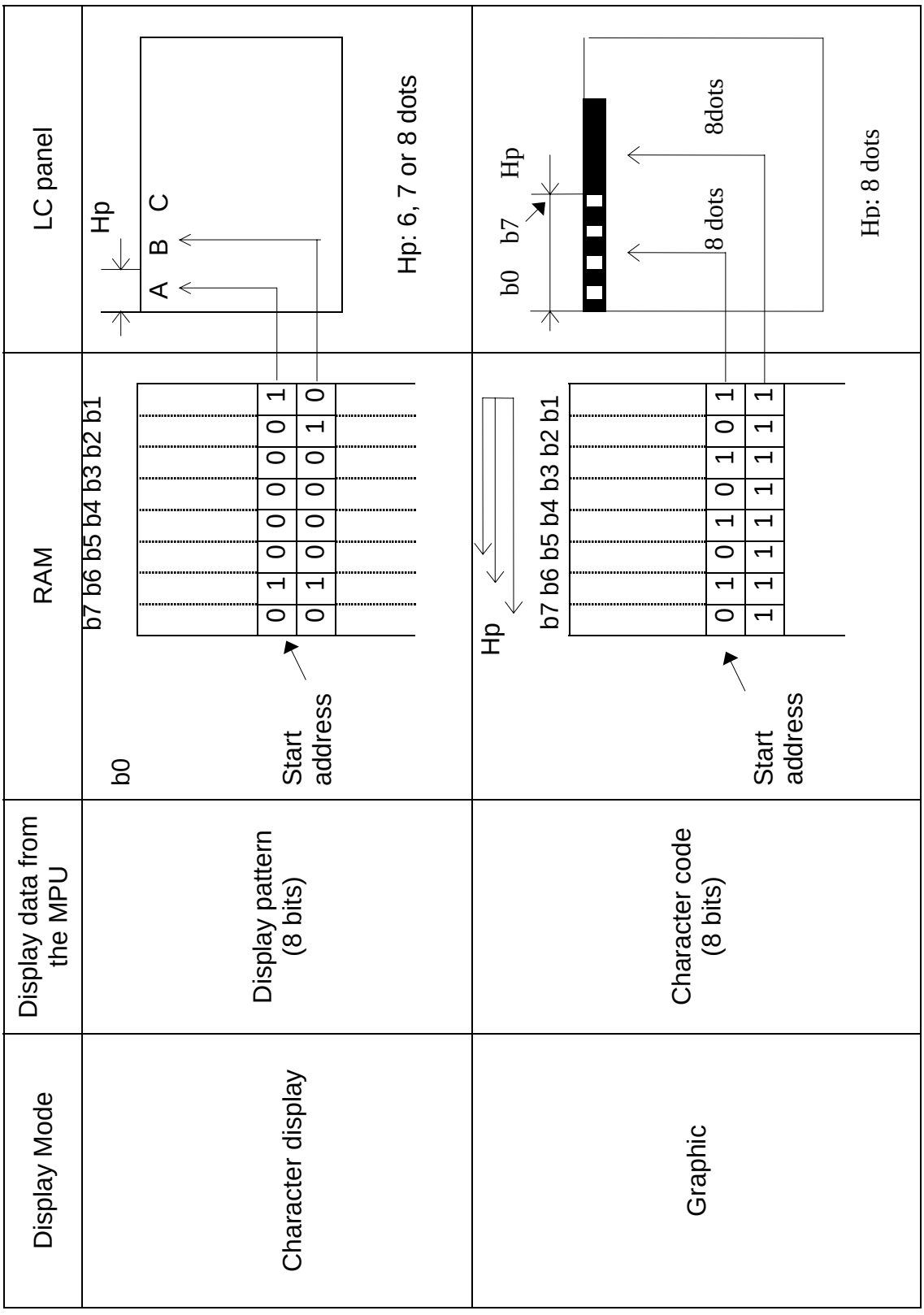


Symbol	Description	Contents	Value
Hp	Horizontal character' pitch	Character pitch in the horizontal direction	6 to 8 dots
H_N	Number of characters in the horizontal direction	Number of characters (digits) per horizontal line or the number of words per line (graphic)	Even digits in the range 2 to 256
Vp	Vertical character pitch	Character pitch in the vertical direction	1 to 16 dots
Cp	Cursor position	The line number at which the cursor is to be display	1 to 16 line
Nx	Number of lines in the vertical direction	Display duty	1 to 256 lines

(Note)
When the number of vertical dots on the screen is m and that of horizontal dots is n,

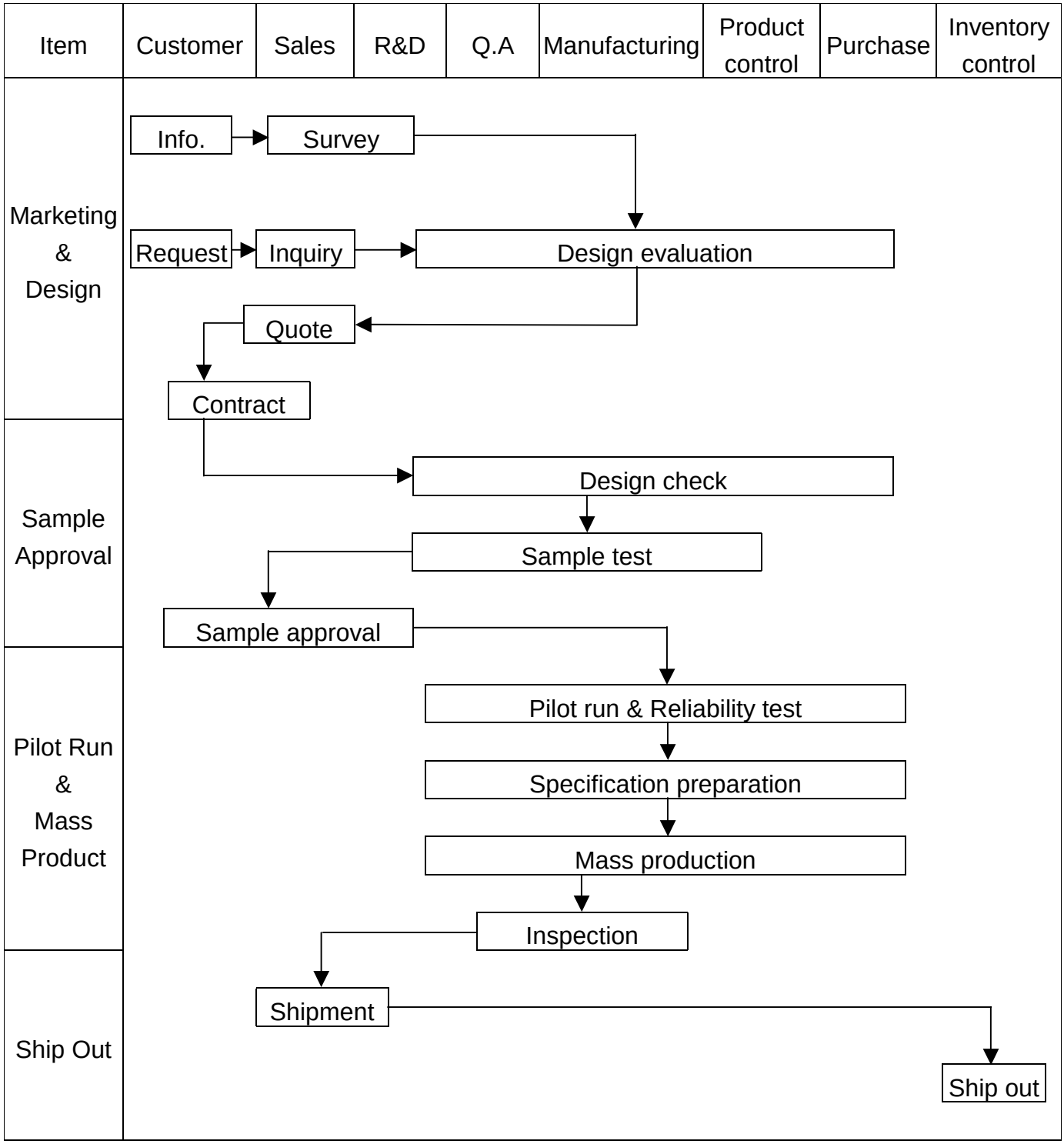
1/m=1/Nx=display duty
$n=Hp*H_N$
m/Vp=number of display lines
$Cp \leq Vp$

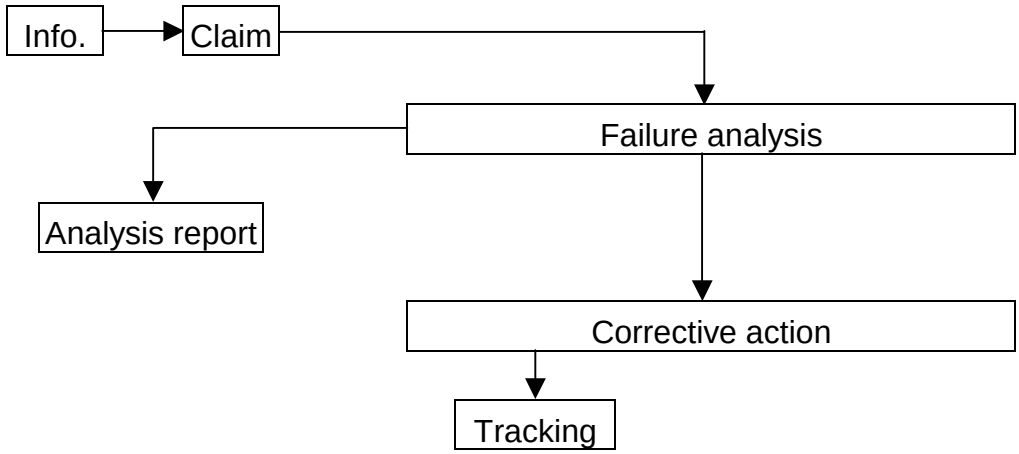
Display mode



3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart

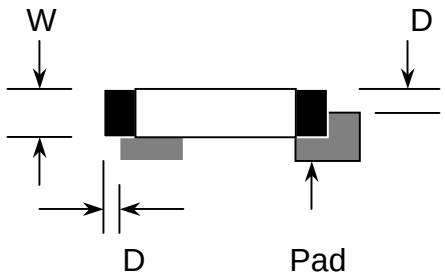


Sales Service	
Q.A Activity	1. ISO 9001 Maintenance Activities 2. Process improvement proposal 3. Equipment calibration 4. Education And Training Activities 5. Standardization Management

3.2 Inspection Specification

Inspection Standard：MIL-STD-105E Table Normal Inspection Single Sampling Level Ⅱ。
Equipment：Gauge、MIL-STD、Powertip Tester、Sample。
IQC Defect Level：Major Defect AQL 0.65; Minor Defect AQL 1.0。
FQC Defect Level：100% Inspection。
OUT Going Defect Level：Sampling。
Specification：

N O	Item	Specification	Judge	Level
1	Part Number	Inconsistent with the P/N on the flow chart of production	N.G.	Major
2	Quantity	Inconsistent Q'TY with the flow chart of production	N.G.	Major
3	Electronic characteristics A=(L + W)÷2	Display short	N.G.	Major
		Missing line	N.G.	Major
		Dot missing A＞1/2 Dot size	N.G.	Major
		No function	N.G.	Major
		Out put data error	N.G.	Major
4	Appearance A=(L + W)÷2 Dirty particle (Include scratch、bubble)	Material difference with flow chart	N.G.	Major
		LCD Assembled in opposite direction	N.G.	Major
		Bezel assembled in opposite direction	N.G.	Major
		Shadow within LCD V./A + 1.0 mm	N.G.	Major
		Dirty particle A＞0.4 mm	N.G.	Minor
		Dirty particle length ＞3.0mm And 0.01mm＜ Width ≦0.05mm (Width＞ 0.05mm Measure by area)	N.G.	Minor
		Without protective film	N.G.	Minor
		Conductive rubber over bezel	N.G.	Minor
5	PCB Appearance A=(L + W)÷2	Burned PCB	N.G.	Major
		Green paint stripped & visible circuit A＞1.0mm (Finish coat not counted in)	N.G.	Minor
		A particle across the circuit	N.G	Minor
		Circuit split ＞1/2 Circuit width	N.G	Minor
		Any circuit risen	N.G	Minor
		0.2mm＜Tin ball area A≦0.4mm And Q'TY＞4 Pieces	N.G	Minor
		Tin ball area A＞0.4mm	N.G	Minor

N O	Item	Specification	Judge	Level
6	Molding appearance A=(L + W)÷2	Too soft：Shape by touch changed	N.G.	Major
		Insufficient epoxy：IC circuit or IC pad visible	N.G.	Minor
		Excessive epoxy：Diameter ＞20mm Or High＞2.5mm	N.G.	Minor
		Pin hole through to IC and A＞0.2mm	N.G.	Minor
7	Bezel appearance A=(L + W)÷2	Angle between frame and TAB＞45° +10°	N.G.	Minor
		Electroplate strip A ＞1.0mm (Top view only)	N.G.	Minor
		Rust (Top view only)	N.G.	Minor
		Crack	N.G.	Minor
8	Backlight electric characteristics A=(L + W)÷2	Error backlight color	N.G.	Major
		No function	N.G.	Major
		Any LED dot no function	N.G.	Major
		PIN soldering without tin A＞1/2 solder pad	N.G.	Minor
		Solder PIN high＞1.5mm	N.G.	Minor
9	LCD Appearance A=(L + W)÷2	Polarize rise over V/A	N.G.	Minor
10	Assembly parts A=(L + W)÷2	Components mark unclearly	N.G.	Minor
		Components' distance more than 0.7mm firm the PCB	N.G.	Minor
		Error position ,not in center D＞1/4W 	N.G.	Minor
		Non- solder area＞Twice solder area	N.G.	Minor
		Flux area A＞1/4 solder area	N.G.	Minor
		Component broken	N.G.	Minor

4. RELIABILITY TEST

4.1 Reliability Test Condition

NO	Item	Test Condition		Applicable Standard
1	High Temperature Storage	Storage At 80 ±2℃ 96~100 hrs Surrounding Temperature，Then Storage At Normal Condition 4hrs.		MIL-202E
2	Low Temperature Storage	Storage At -30 ±2℃ 96~100 hrs Surrounding Temperature, Then Storage At Normal Condition 4hrs.		MIL-202E
3	High Temperature Humidity Storage	1.Storage 96~100 hrs 60 ±2℃, 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4hrs .(Polarizer may fail in this environment). or 2.Storage 96~100 hrs 40 ±2℃, 90~95%RH Surrounding Temperature, Then Storage At Normal Condition 4 hrs.		MIL-202E
4	Temperature Cycling	-20℃ → 25℃ → 70℃ → 25℃ (30Mins) (5Mins) (30Mins) (5Mins) 10 Cycle		MIL-202E
5	Vibration	10~55Hz (1 Minute) 1.5mm X,Y And Z Direction ＊ (Each 2hrs)		MIL-202E
6	Drop Test	Packing Weight (Kg)	Drop High (Cm)	MIL-810E
		0 ~ 45.4	122	
		45.4 ~ 90.8	76	
		90.8 ~ 454	61	
		Over 454	46	

5. PRECAUTION RELATING PRODUCT HANDLING

5.1 SAFETY

5.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.

5.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

5.2 HANDLING

5.2.1 Avoid any strong mechanical shock which can break the glass.

5.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using.

5.2.3 Do not remove the panel or frame from the module.

5.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully , do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

5.2.5 Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.

5.2.6 Do not touch the display area with bare hands , this will stain the display area.

5.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

5.3 STORAGE

5.3.1 Store the panel or module in a dark place where the temperature is 25℃ ±5℃ and the humidity is below 65% RH.

5.3.2 Do not place the module near organics solvents or corrosive gases.

5.3.3 Do not crush , shake , or jolt the module.

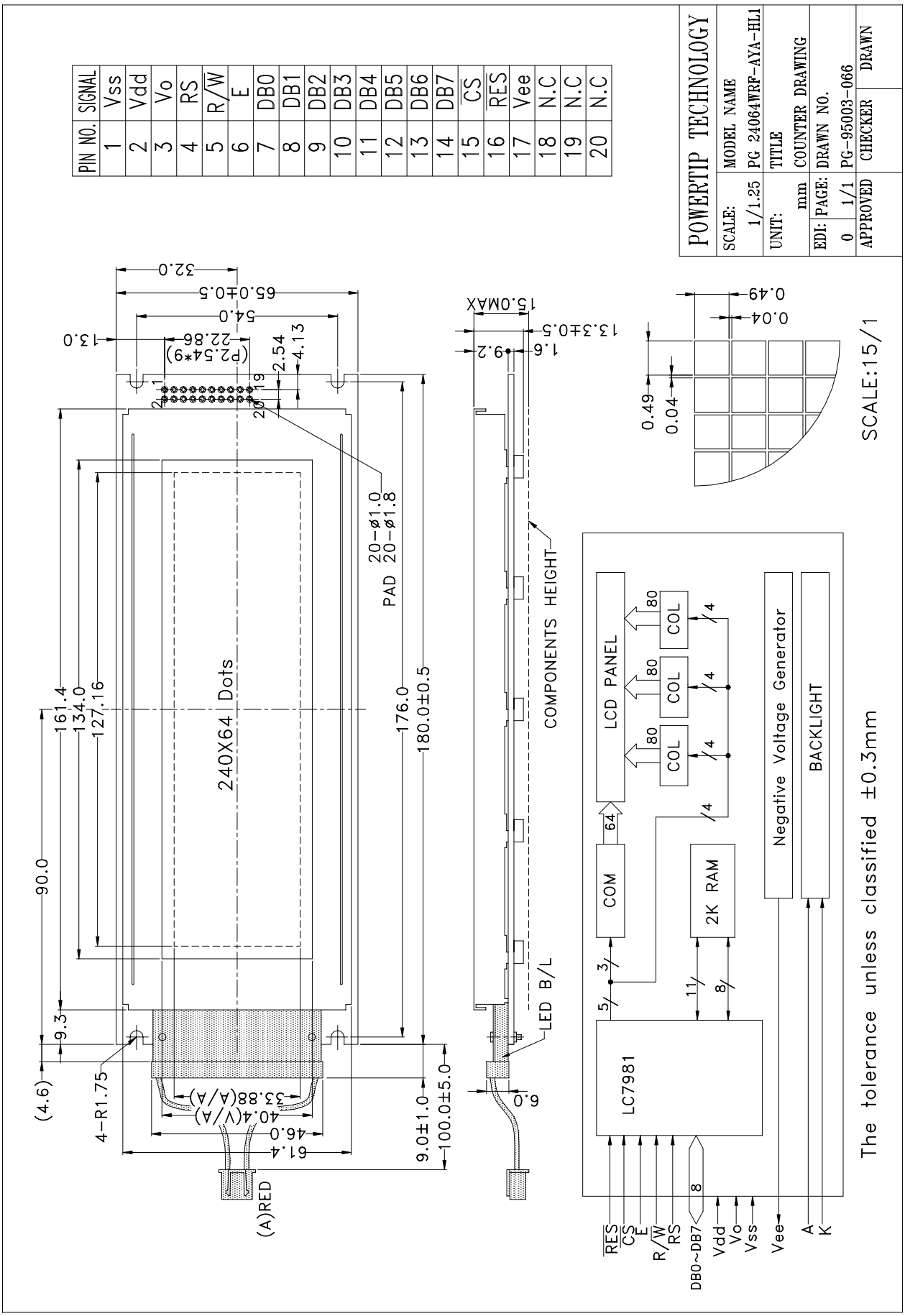
5.4 TERMS OF WARRANTY

5.4.1 Applicable warrant period

The period is within thirteen months since the date of shipping out under normal using and storage conditions.

5.4.2 Unaccepted responsibility

This product has been manufactured to your company's specification as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment , we cannot take responsibility if the product is used in medical devices , nuclear power control equipment , aerospace equipment , fire and security systems or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required.


POWERTIP TECHNOLOGY
SCALE: 1/1.25
MODEL NAME PG 24064WRF-AYA-HL1
UNIT: mm
TITLE COUNTER DRAWING
EDI: 0
PAGE: 1/1
DRAWN NO. PG-95003-066
APPROVED
CHECKER
DRAWN
PIN NO. SIGNAL
1 Vss
2 Vdd
3 Vo
4 RS
5 R/W
6 E
7 DB0
8 DB1
9 DB2
10 DB3
11 DB4
12 DB5
13 DB6
14 DB7
15 CS
16 RES
17 Vee
18 N.C
19 N.C
20 N.C
240X64 Dots
PAD 20-ø1.0 20-ø1.8
COMPONENTS HEIGHT
LED B/L
LCD PANEL
COM
LC7981
2K RAM
Negative Voltage Generator
BACKLIGHT
SCALE:15/1
The tolerance unless classified ±0.3mm