

SPECIFICATIONS

CUSTOMER : PTC
SAMPLE CODE (Ver.) : _____
MASS PRODUCTION CODE (Ver.) : PG9832LRS-AGB-H-Q(VER.0)
DRAWING NO. (Ver.) : PG-96010

Customer Approved

Date: _____

Approved	QC Confirmed	Designer

- Approval For Specifications Only.
 * This specification is subject to change without notice.
 Please contact Powertip or it's representative before designing your product based on this specification.
- Approval For Specifications and Sample.

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RECORDS OF REVISION

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6. THIS PRODUCT CONFORMS THE ROHS OF PTC.

Note : For detailed information please refer to IC data sheet : [SBN1661G-M18-D](#)

1. SPECIFICATIONS

1.1 Features

Item	Standard Value
Display Type	98*32 dots
LCD Type	STN, Gray, Transflective , Positive , Extended Temp.
Driver Condition	LCD Module : 1/32 Duty , 1/6 Bias
Viewing Direction	6 O'clock
Backlight	Yellow-Green LED B/L
Weight	28.0 g
Interface	—
Other(controller/driver IC)	—

1.2 Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	52.0(L) * 44.0(w) * 13.5(H)(Max)	mm
Viewing Area	46.0(L) * 18.5(w)	mm
Active Area	43.08(L) * 15.64(w)	mm
Dot Size	0.40(L) * 0.45(w)	mm
Dot Pitch	0.44(L) * 0.49(w)	mm

Note : For detailed information please refer to LCM drawing

1.3 Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
Power Supply Voltage	V_{DD}	—	-0.3	7.0	V
LCD Driver Supply Voltage	$V_{DD}-V_{EE}$	—	-	13	V
Input Voltage	V_{IN}	—	-0.3	$V_{DD}+0.3$	V
Operating Temperature	T_{OP}	Excluded B/L	-20	70	°C
Storage Temperature	T_{ST}	Excluded B/L	-30	80	°C
Storage Humidity	H_D	$T_a < 40$ °C	20	60	%RH

1.4 DC Electrical Characteristics

$V_{DD} = 5.0 \text{ V} \pm 0.5\text{V}$, $V_{SS} = 0\text{V}$, $T_a = 25^\circ\text{C}$

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	V_{DD}	—	4.5	5.0	5.5	V
“H” Input Voltage	V_{IH}	—	$V_{DD}-2.2$	-	V_{DD}	V
“L” Input Voltage	V_{IL}	—	-	-	0.8	V
“H” Output Voltage	V_{OH}	$I_{OH}=-3.0\text{mA}$	$V_{DD}-0.3$	-	V_{DD}	V
“L” Output Voltage	V_{OL}	$I_{OL}=3.0\text{mA}$	-	-	0.3	V
Supply Current	I_{DD}	$V_{DD} = 5.0 \text{ V}$	-	1.5	3.0	mA
LCM Driver Voltage	V_{OP}	$V_{DD} - V_O (-20^\circ\text{C})$	-	-	-	V
		$V_{DD} - V_O (25^\circ\text{C})$	6.3	6.5	6.7	
		$V_{DD} - V_O (70^\circ\text{C})$	-	-	-	

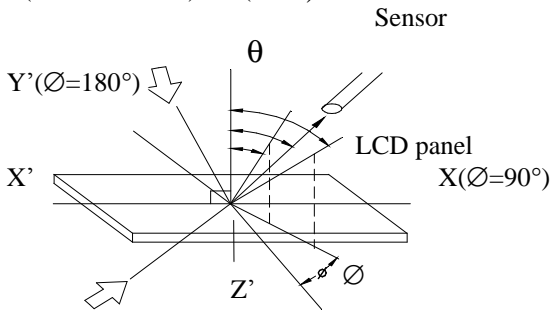
1.5 Optical Characteristics

LCD Panel : 1/32 Duty , 1/6 Bias , $V_{LCD} = 6.36 \text{ V}$, $T_a = 25^\circ\text{C}$

Item	Symbol	Conditions	Min.	Typ.	Max.	Reference
View Angle	θ	$C \geq 2.0, \varnothing = 0^\circ$	40°	-	-	Notes 1 & 2
Contrast Ratio	C	$\theta = 5^\circ, \varnothing = 0^\circ$	5	7	-	Note 3
Response Time(rise)	t_r	$\theta = 5^\circ, \varnothing = 0^\circ$	-	150 ms	-	Note 4
Response Time(fall)	t_f	$\theta = 5^\circ, \varnothing = 0^\circ$	-	280ms	-	Note 4

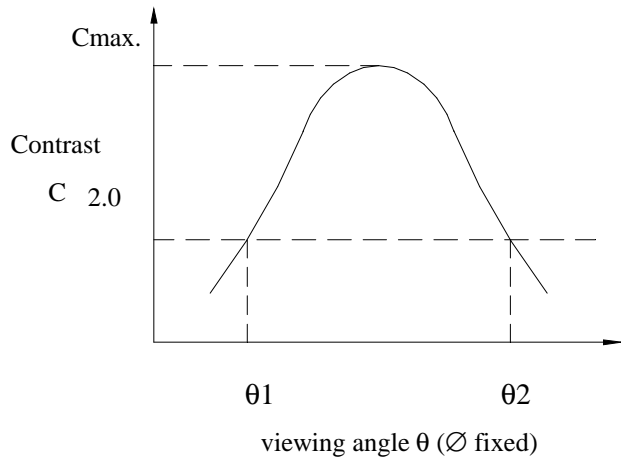
Note 1: Definition of angles θ and \varnothing

Light (when reflected) $z (\theta=0^\circ)$



Light (when transmitted) $Y (\varnothing=0^\circ)$
 $(\theta=90^\circ)$

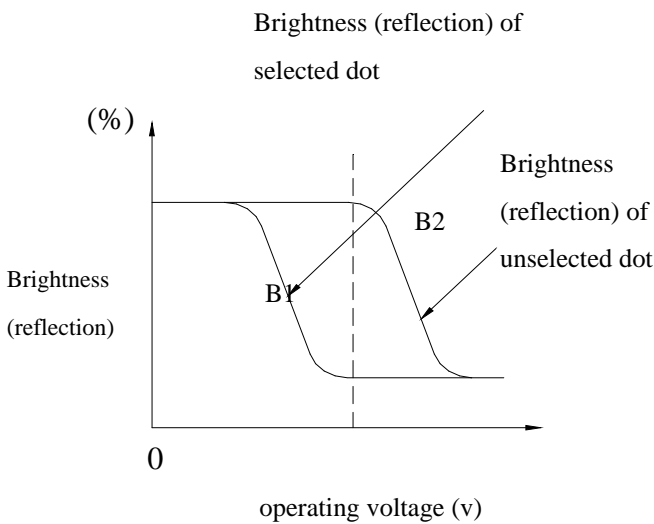
Note 2: Definition of viewing angles θ_1 and θ_2



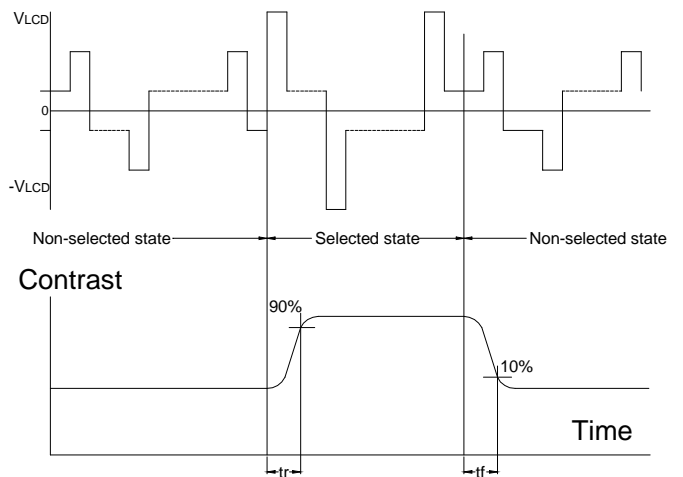
Note : Optimum viewing angle with the naked eye and viewing angle θ at C_{max} . Above are not always the same

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_{LCD} : 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

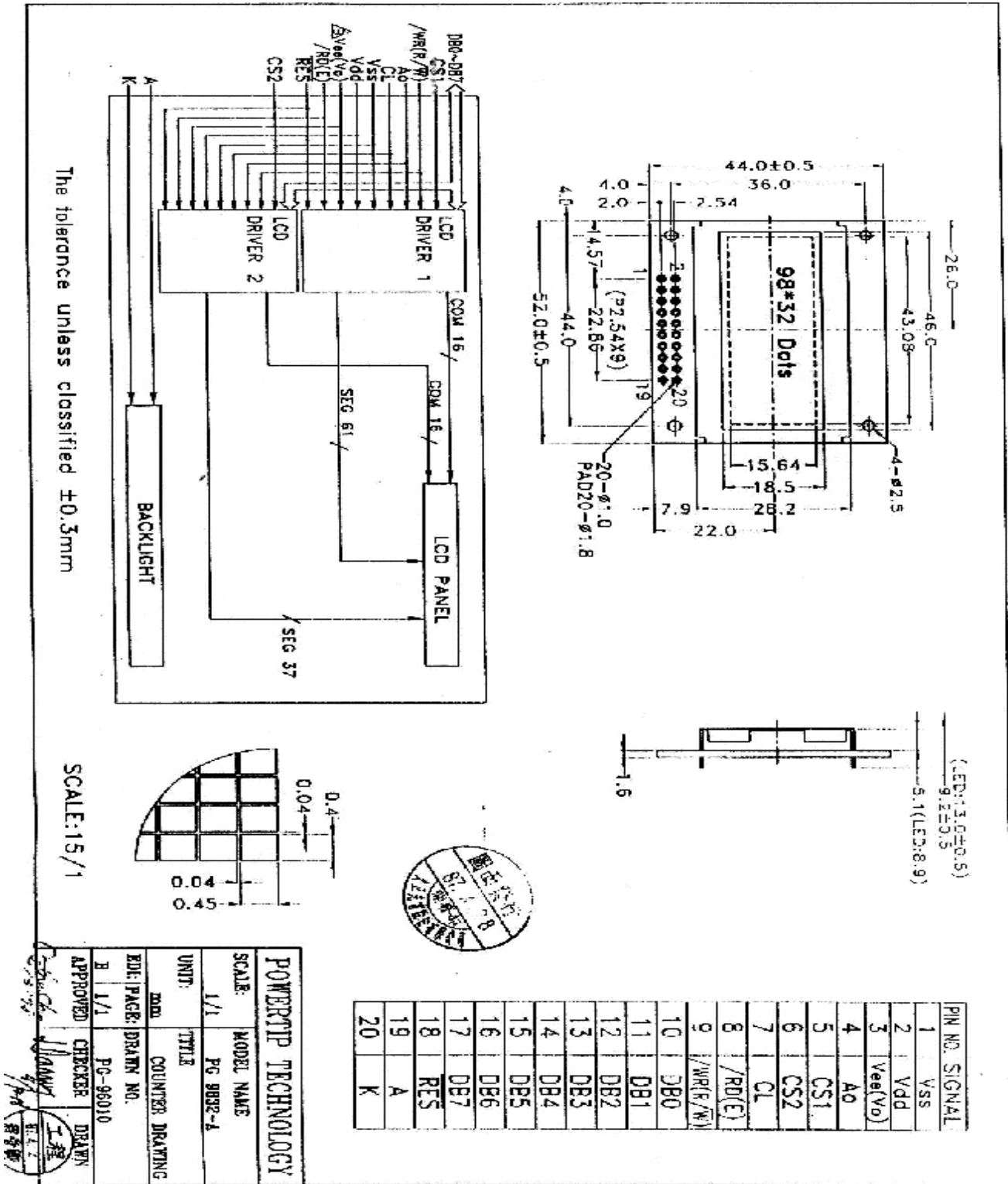
Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	IF	Ta =25°C	-	300	mA
Reverse Voltage	VR	Ta =25°C	-	10	V
Power Dissipation	PO	Ta =25°C	-	1.38	W
Operating Temperature	T _{OP}	-	-20	70	°C
Storage Temperature	T _{ST}	-	-30	80	°C
Solder Temp. for 3 Second	-	-	-	320	°C

Electrical / Optical Characteristics

						Ta =25°C
Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	V _F	I _F =120 mA	-	4.2	4.6	V
Reverse Current	I _R	V _R =10V	-	-	0.12	mA
Average Brightness (without LCD)	I _V	I _F =120 mA	200	250	-	cd/m ²
Wavelength	Hue	I _F =120 mA	569	-	576	nm
Color	Yellow-Green					

2. MODULE STRUCTURE

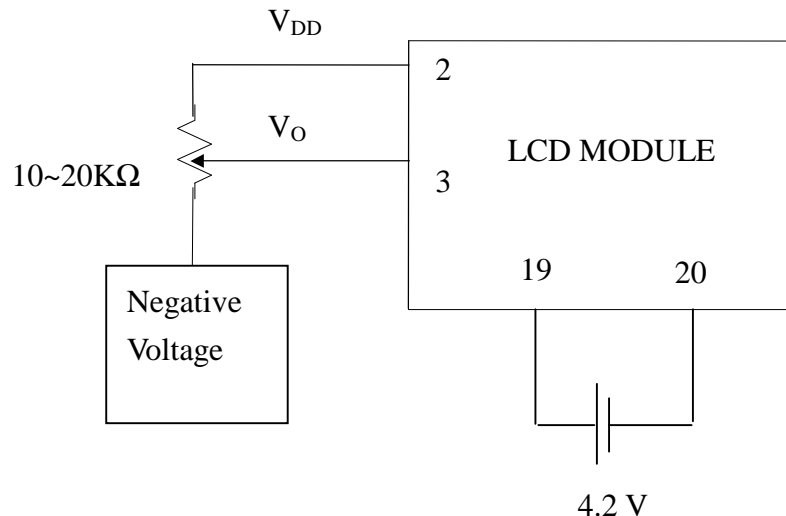
2.1 Counter Drawing



2.2 Interface Pin Description

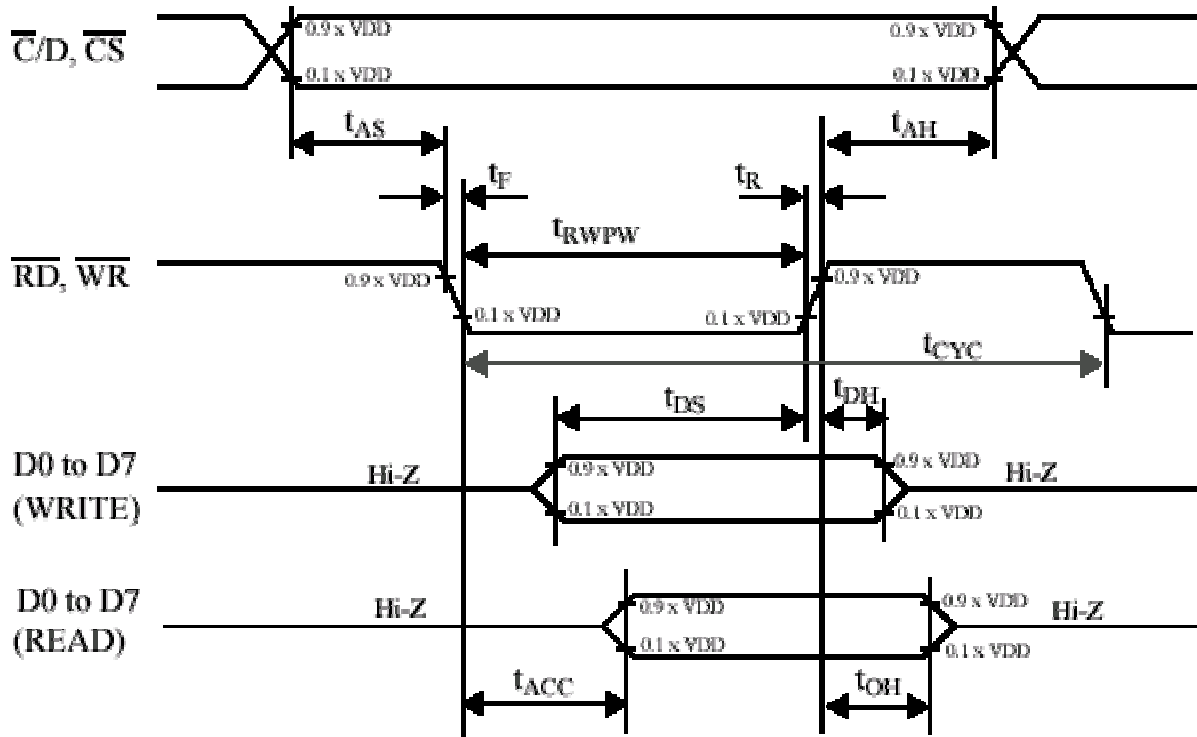
Pin No	Symbol	Function
1	VSS	Power Supply ($V_{SS}=0$)
2	VDD	Power Supply ($V_{DD}>V_{SS}$)
3	VEE(V _O)	Operating voltage for LCD (variable)
4	A0	“L” is instruction “H” is data
5	CS1	Chip enable active “L”, segment 0~segment 61
6	CS2	Chip Enable active “L”, segment 62~segment 98
7	CL	Clock input 2KHZ
8	/RD(E)	Data read (68-family MPU : Enable Signal)
9	/WR(R/W)	Data write (68-family MPU : Data read and write)
10-13	DB0~DB3	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.
14-17	DB4~DB7	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
18	RES	Reset the system
19	A	Power supply for LED backlight (+)
20	K	Power supply for LED backlight (-)

Contrast Adjust



2.3 Timing Characteristics

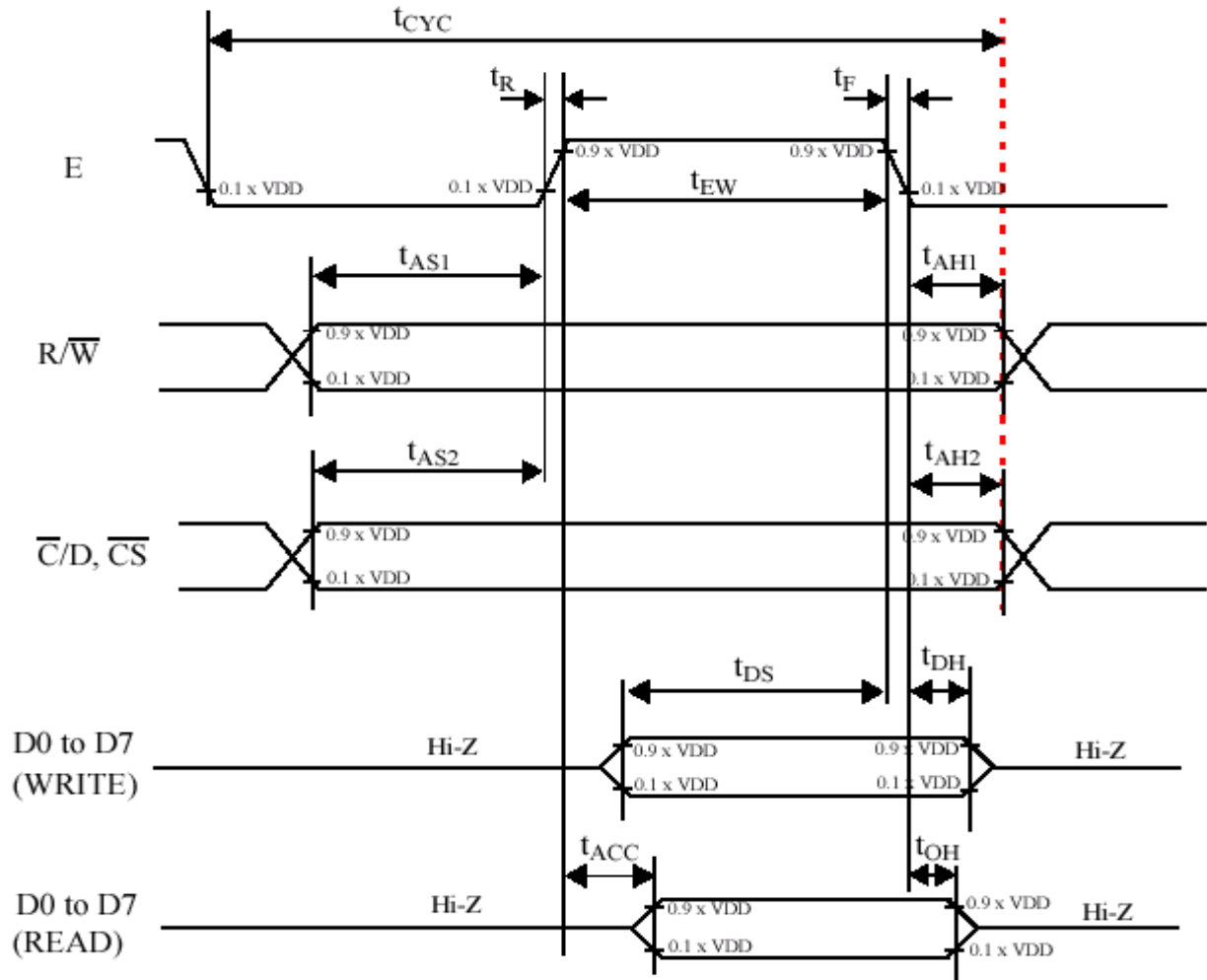
- MPU Bus Read/Write I (80-family MPU)



$V_{DD} = 5\text{ V} \pm 10\%$; $V_{SS} = 0\text{ V}$; $T_{amb} = -20\text{ }^{\circ}\text{C}$ to $+75\text{ }^{\circ}\text{C}$.

symbol	parameter	min.	max.	test conditons	unit
t_{AS}	Address set-up time	20			ns
t_{AH}	Address hold time	10			ns
t_F, t_R	Read/Write pulse falling/rising time		15		ns
t_{RWPW}	Read/Write pulse width	200			ns
t_{CYC}	System cycle time	1000			ns
t_{DS}	Data setup time	80			ns
t_{DH}	Data hold time	10			ns
t_{ACC}	Data READ access time		90	CL= 100 pF.	ns
t_{OH}	Data READ output hold time	10	60		ns

• MPU Bus Read/Write II (68-family MPU)



$V_{DD} = 5\text{ V} \pm 10\%$; $V_{SS} = 0\text{ V}$; $T_{amb} = -20\text{ }^{\circ}\text{C}$ to $+75\text{ }^{\circ}\text{C}$.

symbol	parameter	min.	max.	test conditons	unit
t_{AS1}	Address set-up time with respect to R/W	20			ns
t_{AS2}	Address set-up time with respect to C/D, CS	20			ns
t_{AH1}	Address hold time with respect to R/W	10			ns
t_{AH2}	Address hold time respect with to C/D, CS	10			ns
t_F, t_R	Enable (E) pulse falling/rising time		15		ns
t_{CYC}	System cycle time	1000			ns
t_{EWR}	Enable pulse width for READ	100			ns
t_{EWW}	Enable pulse width for WRITE	80			ns
t_{DS}	Data setup time	80			ns
t_{DH}	Data hold time	10			ns
t_{ACC}	Data access time		90	CL= 100 pF.	ns
t_{OH}	Data output hold time	10	60		ns

2.4 Display Command

COMMAND	COMMAND CODE								FUNCTION
	D7	D6	D5	D4	D3	D2	D1	D0	
Write Display Data	Data to be written into the Display Data Memory.								Write a byte of data to the Display Data Memory.
Read Display Data	Data read from the Display Data Memory.								Read a byte of data from the Display Data Memory.
Read-Modify-Write	1	1	1	0	0	0	0	0	Start Read-Modify-Write operation.
END	1	1	1	0	1	1	1	0	Stop Read-Modify-Write operation.
Software Reset	1	1	1	0	0	0	1	0	Software Reset.

2.4.1 Write Display Data

The Write Display Data command writes a byte (8 bits) of data to the Display Data Memory. Data is put on the data bus by the host microcontroller. The location which accepts this byte of data is pointed to by the Page Address Register and the Column Address Register. At the end of the command operation, the content of the Column Address Register is automatically incremented by 1.

For page address and column address of the Display Data Memory, please refer to Fig. 12.

Table 28 gives the control bus setting for this command.

The setting of the control bus for issuing Write Display Data command

$\overline{C/D}$	$E/(\overline{RD})$	$R/\overline{W(WR)}$
1	1	0

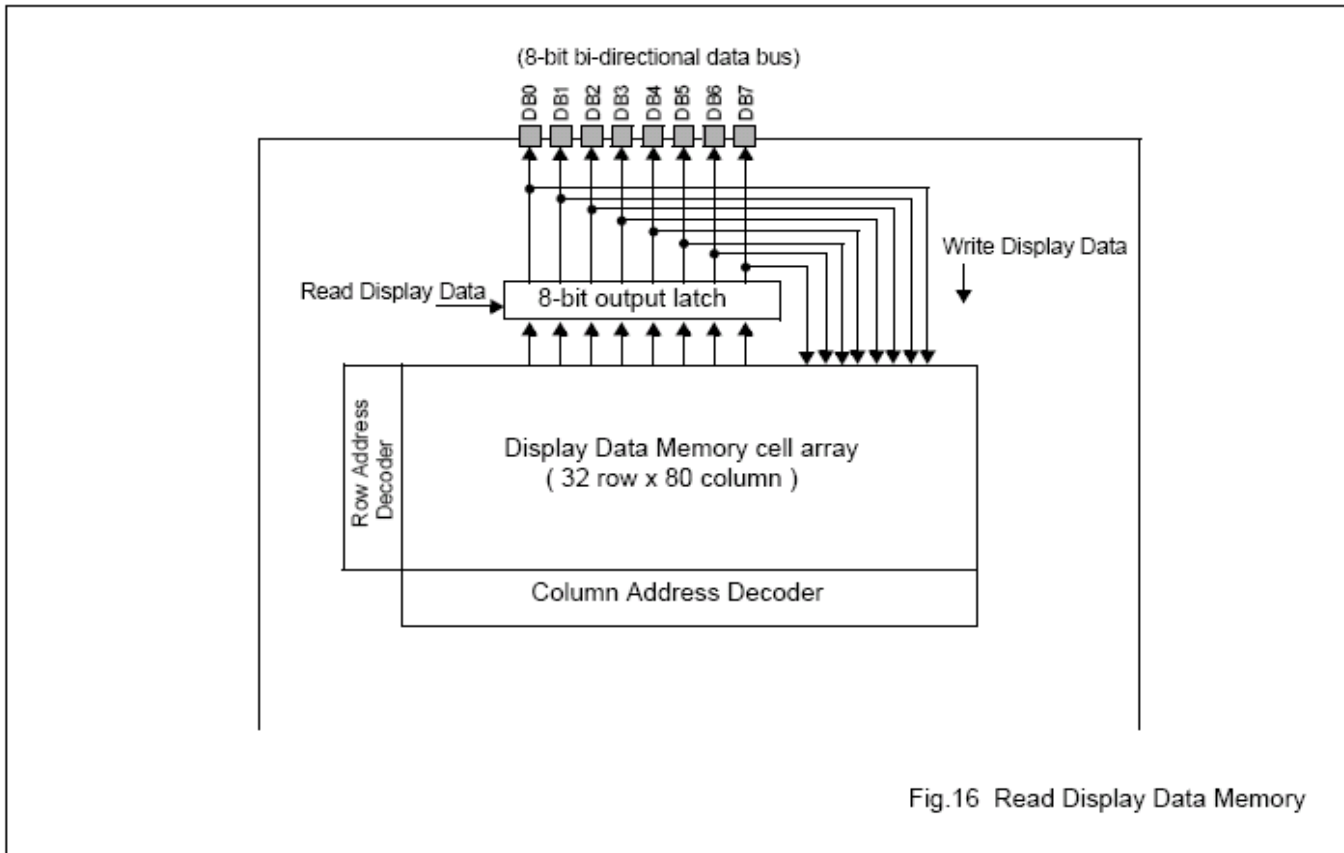
2.4.2

The Read Display Data command starts a 3-step operation.

1. First, the current data of the internal 8-bit output latch of the Display Data Memory is read by the microcontroller, via the 8-bit data bus DB0~DB7.
2. Then, a byte of data of the Display Data Memory is transferred to the 8-bit output latch from a location specified by the Page Address Register and the Column Address Register,
3. Finally, the content of the Column Address Register is automatically incremented by one.

Fig. 16 shows the internal 8-bit output latch located between the 8-bit I/O data bus and the Display Data Memory cell array. Because of this internal 8-bit output latch, a dummy read is needed to obtain correct data from the Display Data Memory.

For Display Data Write operation, a dummy write is not needed, because data can be directly written from the data bus to internal memory cells.



The setting of the control bus for issuing Read Display Command

\overline{C}/D	$E/(\overline{RD})$	$R/\overline{W}(\overline{WR})$
1	0	1

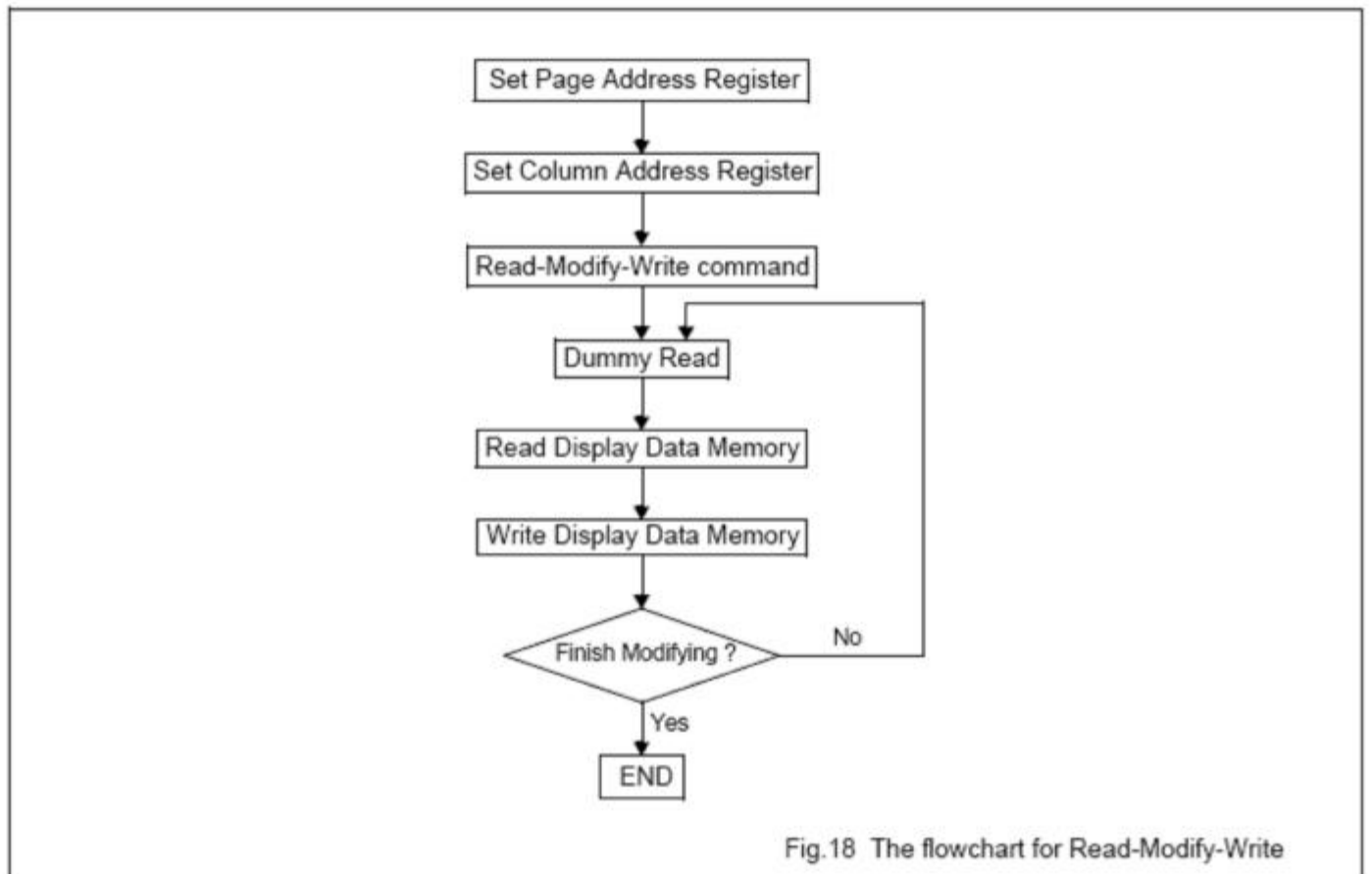
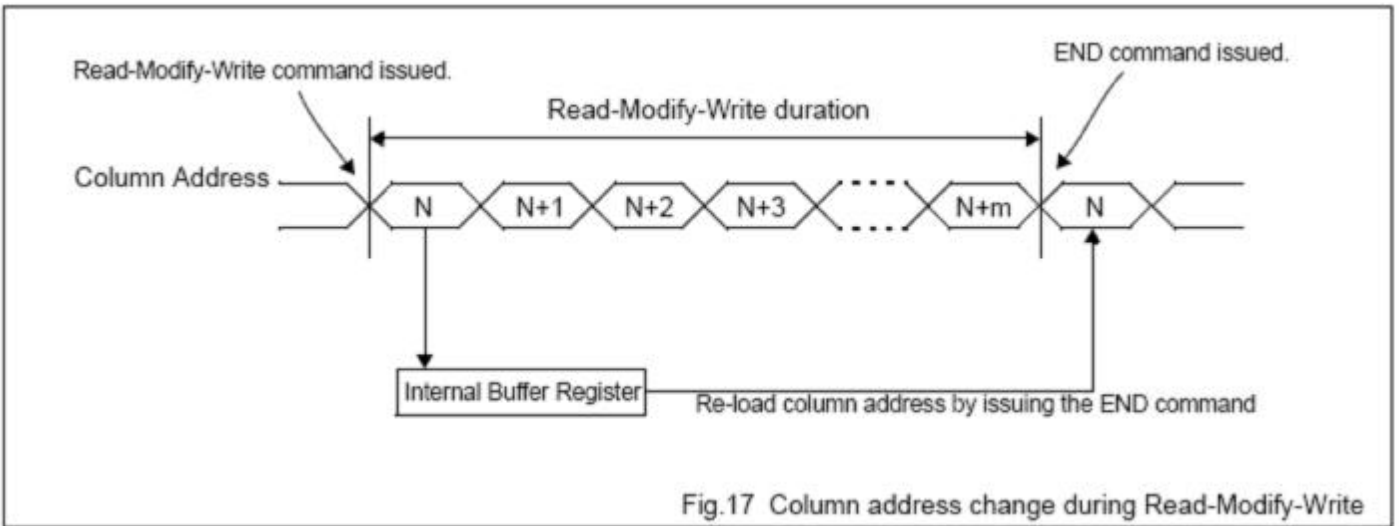
2.4.3 Read-Modify-Write

When the Read-Modify-Write command is issued, the SBN1661G_X enters into Read-Modify-Write mode.

In normal operation, when a Read Display Data command or a Write Display Data command is issued, the content of the Column Address Register is automatically incremented by one after the command operation is finished. However, during Read-Modify-Write mode, the content of the Column Address Register is not incremented by one after a Read Display Data command is finished; only the Write Display Data command can make the content of the Column Address Register automatically incremented by one after the command operation is finished.

During Read-Modify-Write mode, any other registers, except the Column Address Register, can be modified. This command is useful when a block of the Display Data Memory needs to be repeatedly read and updated.

Fig. 17 gives the change sequence of the Column Address Register during Read-Modify-Write mode. Figure 18 gives the flow chart for Read-Modify-Write command.



The setting of the control bus for the Read-Modify-Write command

\overline{C}/D	$E/(\overline{RD})$	$R/\overline{W}(\overline{WR})$
0	1	0

The setting of the data bus for the Read-Modify-Write command

D7(MSB)	D6	D5	D4	D3	D2	D1	D0(LSB)
1	1	1	0	0	0	0	0

The command code is E0 Hex.

2.4.4 The END command

The END command releases the Read-Modify-Write mode and re-loads the Column Address Register with the value previously stored in the internal buffer (refer to Fig. 17) when the Read-Modify-Write command was issued.

Table 32 gives the setting for the control bus and the setting of the data bus is given in Table 33.

The setting of the control bus for the END command

\overline{C}/D	$E/(\overline{RD})$	$R/\overline{W}(\overline{WR})$
0	1	0

The setting of the data bus for the END command

D7(MSB)	D6	D5	D4	D3	D2	D1	D0(LSB)
1	1	1	0	1	1	1	0

The command code is EE Hex.

2.4.5 Software RESET command

The Software Reset command is different from the hardware reset and can not be used to replace hardware reset.

When Software Reset is issued by the host microcontroller,

- the content of the Display Start Line Register is cleared to zero(A4~A0=00000),
- the Page Address Register is set to 3 (A1 A0 = 11),
- the content of the Display Data Memory remains unchanged, and
- the content of all other registers remains unchanged.

Table 34 gives the setting for the control bus and the setting of the data bus is given in Table 35.

The setting of the control bus for the Software RESET Command

\overline{C}/D	$E/(\overline{RD})$	$R/\overline{W}(\overline{WR})$
0	1	0

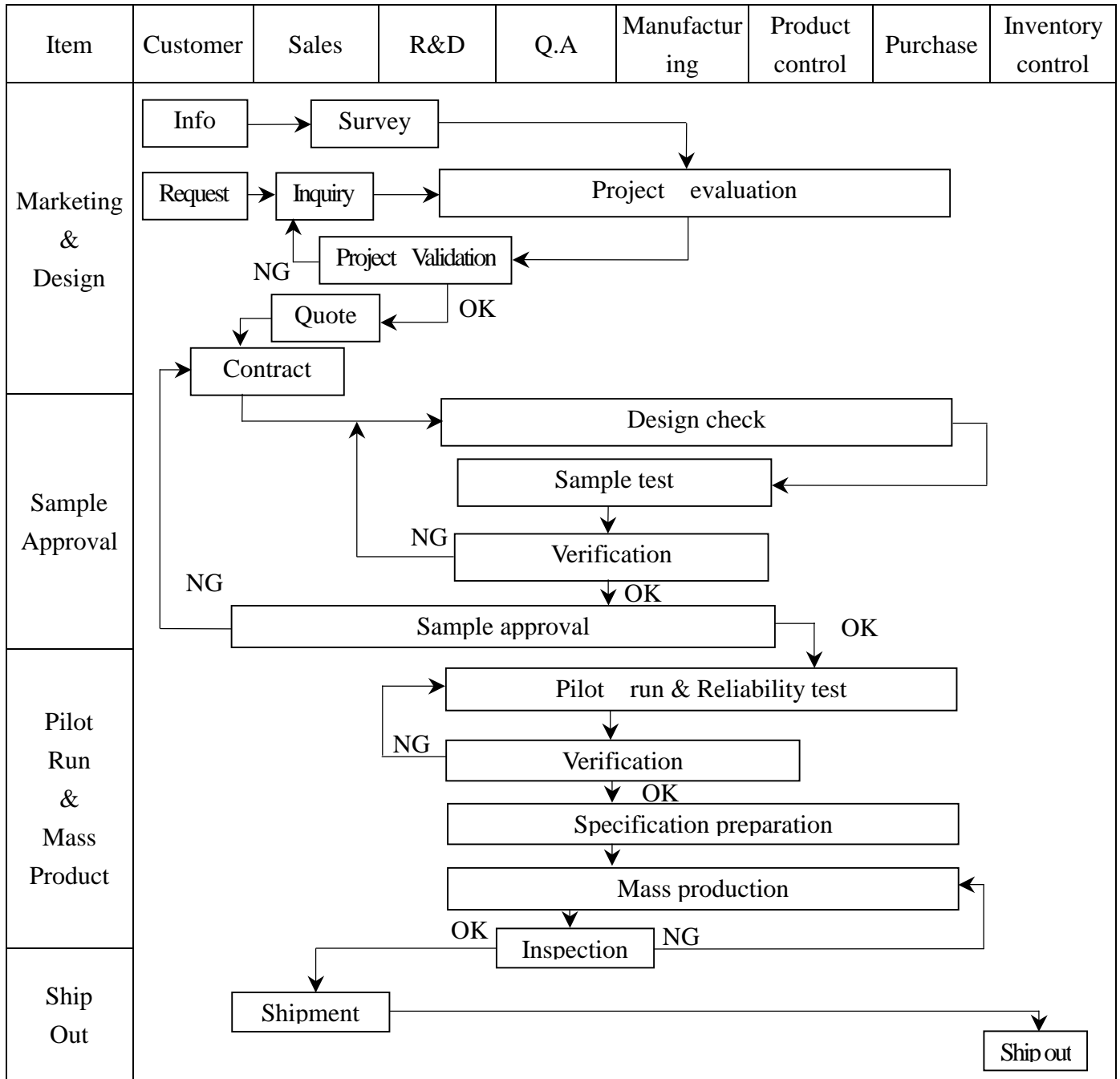
The setting of the data bus for the Software RESET Command

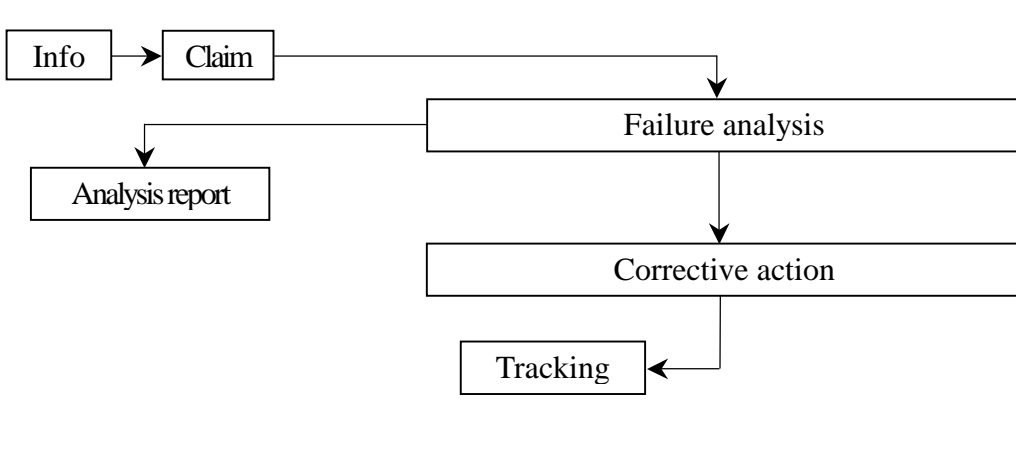
D7(MSB)	D6	D5	D4	D3	D2	D1	D0(LSB)
1	1	1	0	0	0	1	0

The command code is E2 Hex.

3. QUALITY ASSURANCE SYSTEM

3.1 Quality Assurance Flow Chart



Item	Customer	Sales	R&D	Q.A	Manufacturing	Product control	Purchase	Inventory control
Sales Service	 <pre> graph TD Info[Info] --> Claim[Claim] Claim --> FA[Failure analysis] FA --> AR[Analysis report] FA --> CA[Corrective action] CA --> Tracking[Tracking] </pre>							
Q.A Activity	1. ISO 9001 Maintenance Activities 3. Equipment calibration 5. Standardization Management				2. Process improvement proposal 4. Education And Training Activities			

3.2 Inspection Specification

Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level II ◦

Equipment : Gauge 、 MIL-STD 、 Powertip Tester 、 Sample ◦

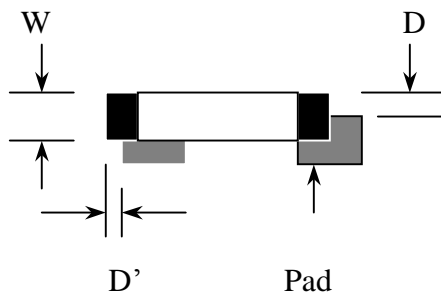
IQC Defect Level : Major Defect AQL 0.4; Minor Defect AQL 1.5 ◦

FQC Defect Level : 100% Inspection ◦

OUT Going Defect Level : Sampling ◦

Specification :

NO	Item	Specification	Judge	Level
1	Part Number	The part number is inconsistent with work order of production	N.G.	Major
2	Quantity	The quantity is inconsistent with work order of production	N.G.	Major
3	Electronic characteristics of LCM $A=(L+W) \div 2$	The display lacks of some patterns.	N.G.	Major
		Missing line.	N.G.	Major
		The size of missing dot, A is $> 1/2$ Dot size	N.G.	Major
		There is no function.	N.G.	Major
		Output data is error	N.G.	Major
4	Appearance of LCD $A=(L+W) \div 2$ Dirty particle (Including scratch 、 bubble)	Material is different with work order of production	N.G.	Major
		LCD is assembled in inverse direction	N.G.	Major
		Bezel is assembled in inverse direction	N.G.	Major
		Shadow is within LCD viewing area + 0.5 mm	N.G.	Major
		The diameter of dirty particle, A is > 0.4 mm	N.G.	Minor
		Dirty particle length is > 3.0 mm, and 0.01 mm $<$ width ≤ 0.05 mm	N.G.	Minor
		Display is without protective film	N.G.	Minor
		Conductive rubber is over bezel 1mm	N.G.	Minor
		Polarizer exceeds over viewing area of LCD	N.G.	Minor
		Area of bubble in polarizer, A > 1.0 mm, the number of bubble is > 1 piece.	N.G.	Minor
0.4mm $<$ Area of bubble in polarizer, A < 1.0 mm, the number of bubble is > 4 pieces.	N.G.	Minor		
5	Appearance of PCB $A=(L+W) \div 2$	Burned area or wrong part number is on PCB	N.G.	Major
		The symbol, character, and mark of PCB are unidentifiable.	N.G.	Minor
		The stripped solder mask , A is > 1.0 mm	N.G.	Minor
		0.3mm $<$ stripped solder mask or visible circuit, A < 1.0 mm, and the number is ≥ 4 pieces	N.G.	Minor
		There is particle between the circuits in solder mask	N.G.	Minor
		The circuit is peeled off or cracked	N.G.	Minor
		There is any circuits risen or exposed.	N.G.	Minor
		0.2mm $<$ Area of solder ball, A is ≤ 0.4 mm	N.G.	Minor
		The number of solder ball is ≥ 3 pieces	N.G.	Minor
The magnitude of solder ball, A is > 0.4 mm.	N.G.	Minor		

NO	Item	Specification	Judge	Level
6	Appearance of molding $A=(L+W)\div 2$	The shape of modeling is deformed by touching.	N.G.	Major
		Insufficient epoxy: Circuit or pad of IC is visible	N.G.	Minor
		Excessive epoxy: Diameter of modeling is $> 20\text{mm}$ or height is $> 2.5\text{mm}$	N.G.	Minor
		The diameter of pinhole in modeling, A is $> 0.2\text{mm}$.	N.G.	Minor
7	Appearance of frame $A=(L+W)\div 2$	The folding angle of frame must be $> 45^\circ + 10^\circ$	N.G.	Minor
		The area of stripped electroplate in top-view of frame, A is $> 1.0\text{mm}$.	N.G.	Minor
		Rust or crack is (Top view only)	N.G.	Minor
		The scratched width of frame is $> 0.06\text{mm}$. (Top view only)	N.G.	Minor
8	Electrical characteristic of backlight $A=(L+W)\div 2$	The color of backlight is nonconforming	N.G.	Major
		Backlight can't work normally.	N.G.	Major
		The LED lamp can't work normally	N.G.	Major
		The unsoldering area of pin for backlight, A is $> 1/2$ solder joint area.	N.G.	Minor
		The height of solder pin for backlight is $> 2.0\text{mm}$	N.G.	Minor
10	Assembly parts $A=(L+W)\div 2$	The mark or polarity of component is unidentifiable.	N.G.	Minor
		The height between bottom of component and surface of the PCB is floating $> 0.7\text{mm}$	N.G.	Minor
		$D > 1/4W$ 	N.G.	Minor
		End solder joint width, D' is $> 50\%$ width of component termination or width of pad	N.G.	Minor
		Side overhang, D is $> 25\%$ width of component termination.	N.G.	Minor
		Component is cracked, deformed, and burned, etc.	N.G.	Minor
		The polarity of component is placed in inverse direction.	N.G.	Minor
		Maximum fillet height of solder extends onto the component body or minimum fillet height is $< 0.5\text{mm}$.	N.G.	Minor

4. RELIABILITY TEST

4.1 Reliability Test Condition

NO	Item	Test Condition	
1	High Temperature Storage	Storage at $80 \pm 2^{\circ}\text{C}$ 96~100 hrs Surrounding temperature, then storage at normal condition 4hrs	
2	Low Temperature Storage	Storage at $-30 \pm 2^{\circ}\text{C}$ 96~100 hrs Surrounding temperature, then storage at normal condition 4hrs	
3	High Temperature /Humidity Storage	1.Storage 96~100 hrs $60 \pm 2^{\circ}\text{C}$, 90~95%RH surrounding temperature, then storage at normal condition 4hrs. (Excluding the polarizer). or 2.Storage 96~100 hrs $40 \pm 2^{\circ}\text{C}$, 90~95%RH surrounding temperature, then storage at normal condition 4 hrs.	
4	Temperature Cycling	$-20^{\circ}\text{C} \rightarrow 25^{\circ}\text{C} \rightarrow 70^{\circ}\text{C} \rightarrow 25^{\circ}\text{C}$ $\leftarrow (30\text{mins}) (5\text{mins}) (30\text{mins}) (5\text{mins}) \rightarrow$ <p style="text-align: center;">10 Cycle</p>	
5	Vibration	10~55Hz (1 minute) 1.5mm X,Y and Z direction * (each 2hrs)	
6	ESD Test	Air Discharge: Apply 6 KV with 5 times discharge for each polarity +/-	Contact Discharge: Apply 250V with 5 times discharge for each polarity +/-
		Testing location: Around the face of LCD	Testing location: 1.Apply to bezel. 2.Apply to Vdd, Vss.
7	Drop Test	Packing Weight (Kg)	Drop Height (cm)
		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.
- 5.2.8 To control temperature and time of soldering is $320\pm 10^{\circ}\text{C}$ and 3-5 sec.
- 5.2.9 To avoid liquid (include organic solvent) stained on LCM .

5.3 STORAGE

- 5.3.1 Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ 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 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.