Specification

BTHQ 128064 AVF-FFEMN-06-LED04YG

Version November 2007

DOCUMENT REVISION HISTORY

DOCUMENT REVISION FROM TO	DATE	DESCRIPTION	CHANGED BY	CHECKED BY
A	2007.11.20	First Release. Based on a.) LCD specification BTF_12864_V01, LCD cover page Rev.A, 2007.08.30 with counter drawing BTF-12864 (REV.1). b.) VL-QUA-012B REV.W 2004.03.20 According to VL-QUA-012B, LCD size is small because Unit Per Laminate=16 which is more than 6pcs/Laminate.	LINDA ZHU	XIE HU

CONTENTS

Preliminary Specification
of
LCD Module Type
Model No.: BTF12864-02

1. General Description

- 128 x 64 dots FFSTN, negative, B & W, transmissive, LCD graphic module.
- Viewing angle: 6 o'clock.
- Driving scheme: 1/65 duty, 1/9 bias.
- Driving IC: 'NOVATEK' NT7534H-TABF1 (TAB) LCD controller/driver or equivalent.
- Logic voltage: 3V.
- Yellow-green LED04 backlight.
- FPC connection.
- "RoHS" compliance.

2. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

Parameter	Specifications	Unit
Outline dimensions	74.0(W) x 41.9(H) x 17.0(D) (Excluded FPC)	mm
Active area	61.425(W) x 30.705(H)	mm
Display format	128(W) x 64(H)	dots
Dot size	0.465(W) x 0.465(H)	mm
Dot spacing	0.015(W) x 0.015(H)	mm
Dot pitch	0.48(W) x 0.48(H)	mm
Weight	Approx: 47	gram

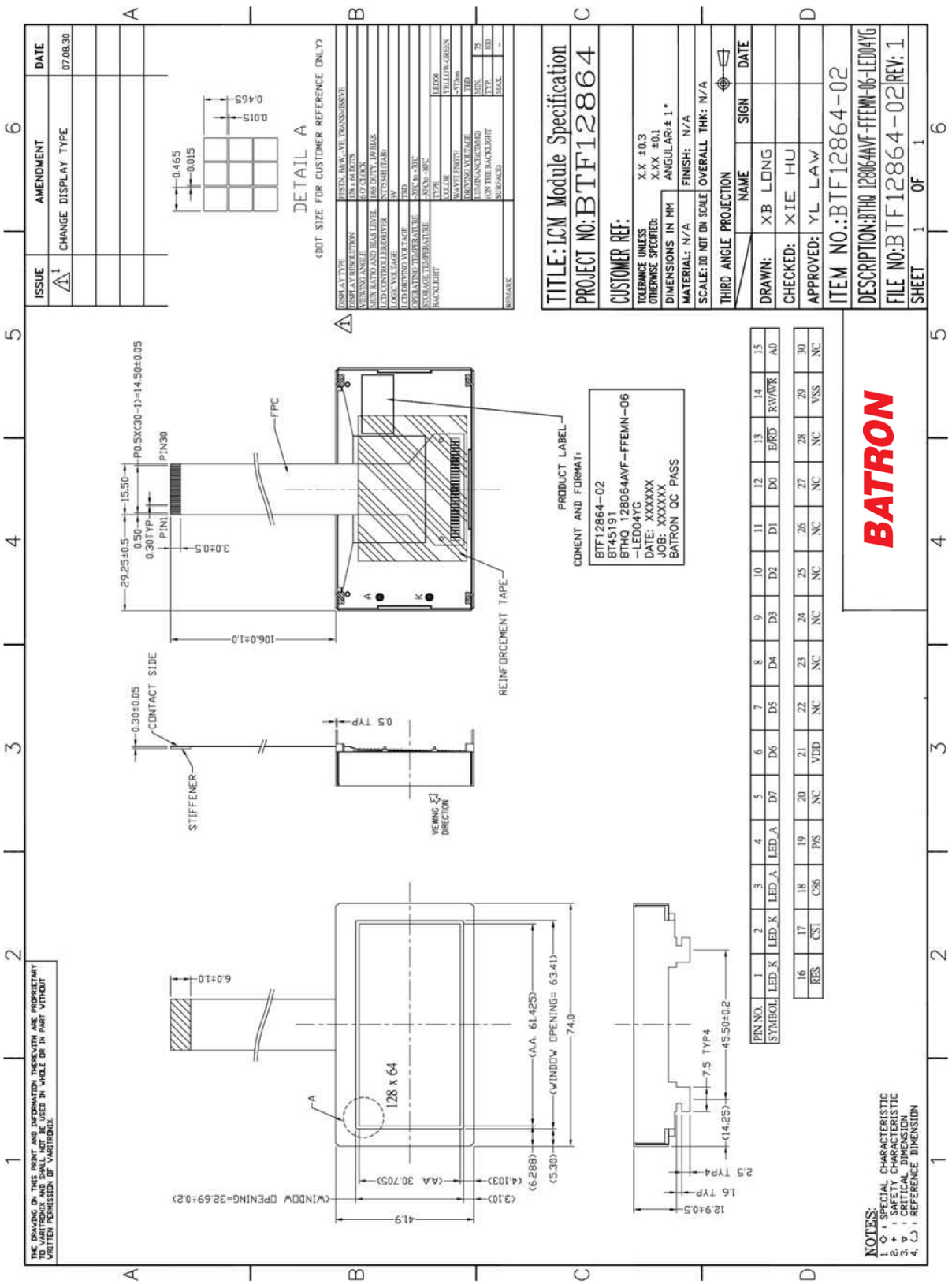


Figure 1: Module Specification

6. L

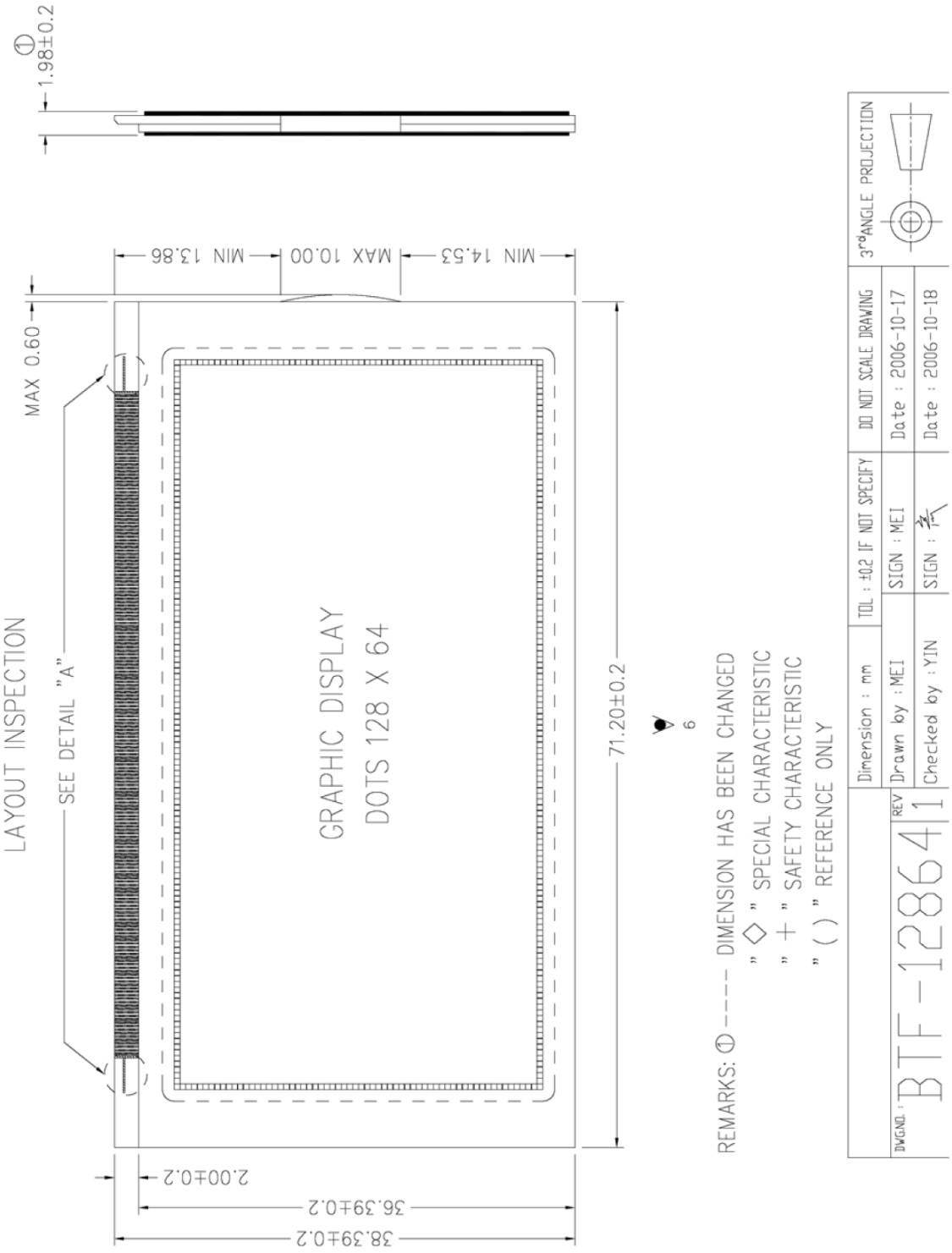


Figure 6: LCD Drawing 1

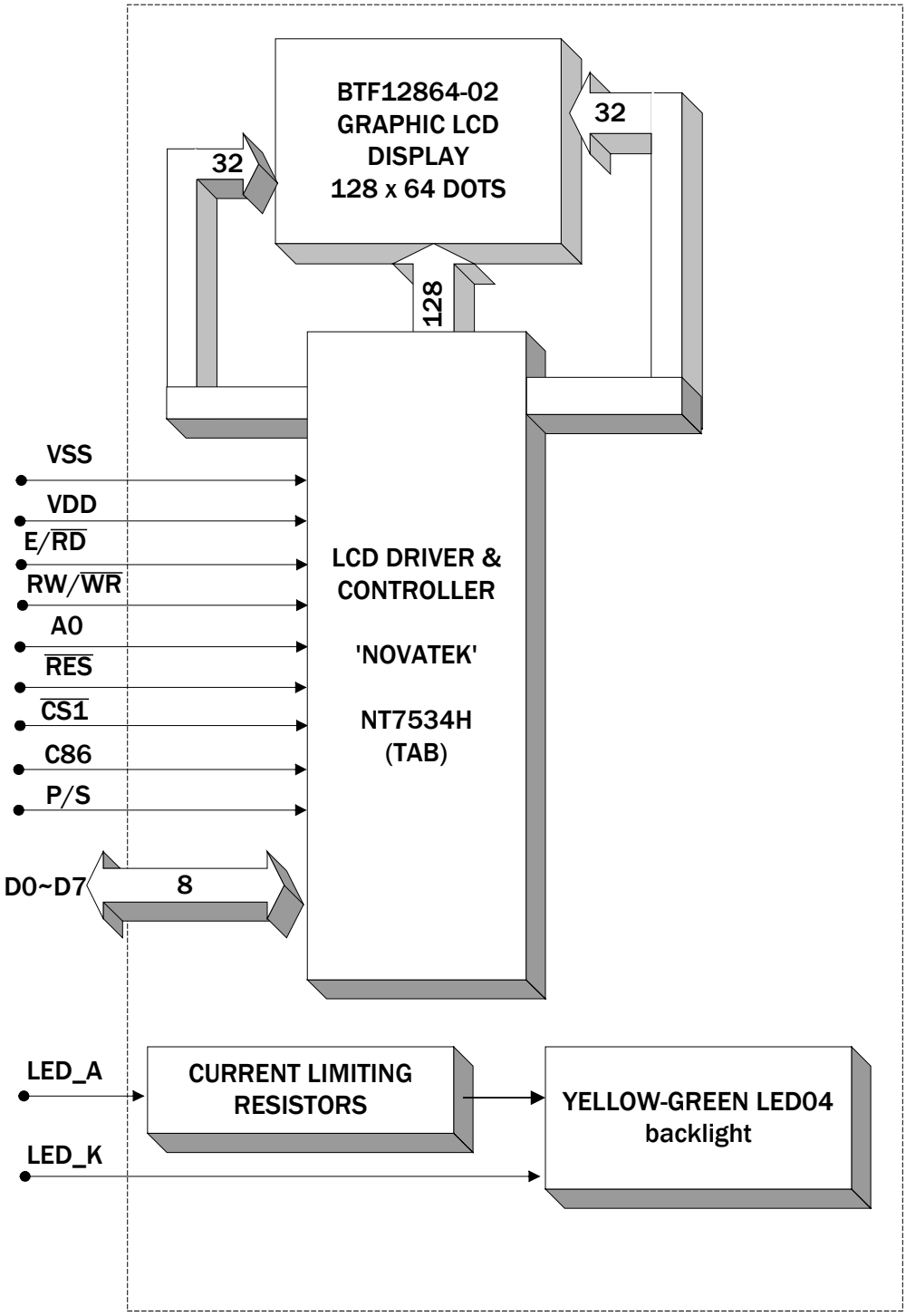


Figure 2: Block Diagram

3. Interface signals

Table 2(a)

Pin No.	Symbol	Description
1	LED_K	Cathode of backlight.
2	LED_K	Cathode of backlight.
3	LED_A	Anode of backlight.
4	LED_A	Anode of backlight.
5	D7	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the chip select is inactive, D0 to D7 are set to high impedance.
6	D6	
7	D5	
8	D4	
9	D3	
10	D2	
11	D1	
12	D0	
13	E/$\overline{RD}$	When connected to an 8080 MPU, it is active LOW. This pad is connected to the $\overline{RD}$ signal of the 8080MPU, and the NT7534 data bus is in an output status when this signal is "L". When connected to a 6800 Series MPU, this is active HIGH. This is used as an enable clock input of the 6800 series MPU.
14	RW/$\overline{WR}$	When connected to an 8080 MPU, this is active LOW. This terminal connects to the 8080 MPU $\overline{WR}$ signal. The signals on the data bus are latched at the rising edge of the $\overline{WR}$ signal. When connected to a 6800 Series MPU, this is the read/write control signal input terminal. When RW = "H": Read When RW = "L": Write
15	A0	This is connected to the least significant bit of the normal MPU address bus, and it determines whether the data bits are data or a command. A0 = "H": Indicate that D0 to D7 are display data A0 = "L": Indicates that D0 to D7 are control data
16	$\overline{RES}$	When $\overline{RES}$ is set to "L", the settings are initialized. The reset operation is performed by the $\overline{RES}$ signal level.
17	$\overline{CS1}$	This is the chip select signal. When $\overline{CS1}$ = "L", then the chip select becomes active, and data/command I/O is enabled.
18	C86	This is the MPU interface switch terminal C86 = "H": 6800 Series MPU interface C86 = "L": 8080 Series MPU interface

Table 2(b)

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Description</th></tr>
<tr><td>19</td><td>P/S</td><td>This is the parallel data input/serial data input switch terminal
P/S = “H”: Parallel data input
P/S = “L”: Serial data input
The following applies depending on the P/S status:
<table>
<tr><th>P/S</th><th>Data/Command</th><th>Data</th><th>Read/Write</th><th>Serial Clock</th></tr>
<tr><td>H</td><td>A0</td><td>D0 to D7</td><td>E/$\overline{RD}$, RW/$\overline{WR}$</td><td>-</td></tr>
<tr><td>L</td><td>A0</td><td>SI (D7)</td><td>Write only</td><td>SCL (D6)</td></tr>
</table>
When P/S = “L”, D0 to D5 are HZ. D0 to D5 may be “H”, “L” or Open. /RD (E) and /WR (R/W) are fixed to either “H” or “L”.
With serial data input, RAM display data reading is not supported.</td></tr>
<tr><td>20</td><td>NC</td><td>No connection.</td></tr>
<tr><td>21</td><td>VDD</td><td>Power supply input.</td></tr>
<tr><td>22</td><td>NC</td><td>No connection.</td></tr>
<tr><td>23</td><td>NC</td><td>No connection.</td></tr>
<tr><td>24</td><td>NC</td><td>No connection.</td></tr>
<tr><td>25</td><td>NC</td><td>No connection.</td></tr>
<tr><td>26</td><td>NC</td><td>No connection.</td></tr>
<tr><td>27</td><td>NC</td><td>No connection.</td></tr>
<tr><td>28</td><td>NC</td><td>No connection.</td></tr>
<tr><td>29</td><td>VSS</td><td>Ground.</td></tr>
<tr><td>30</td><td>NC</td><td>No connection.</td></tr>
</table>

4. Absolute Maximum Ratings

4.1 Electrical Maximum Ratings – For IC Only

Table 3

Parameter	Symbol	Min.	Max.	Unit
DC supply voltage (logic)	VDD - VSS	-0.3	+4.0	V
DC supply voltage (Vout)	Vout	-0.3	+15.0	V
DC supply voltage (V0)	V0	-0.3	+15.0	V
Input voltage	VIN	-0.3	VDD +0.3	V

Note:

The modules may be destroyed if they are used beyond the absolute maximum ratings.

All voltage values are referenced to VSS = 0V.

4.2 Environmental Condition

Table 4

Item	Operating temperature (Topr)		Storage temperature (Tstg) (Note 1)		Remark
	Min.	Max.	Min.	Max.	
Ambient temperature	-20°C	+70°C	-30°C	+80°C	Dry
Humidity (Note 1)	90% max. RH for Ta ≤ 40°C < 50% RH for 40°C < Ta ≤ Maximum operating temperature				No condensation
Vibration (IEC 68-2-6) cells must be mounted on a suitable connector	Frequency: 10 ~ 55 Hz Amplitude: 0.75 mm Duration: 20 cycles in each direction.				3 directions
Shock (IEC 68-2-27) Half-sine pulse shape	Pulse duration: 11 ms Peak acceleration: 981 m/s^2 = 100g Number of shocks: 3 shocks in 3 mutually perpendicular axes.				3 directions

Note 1: Product cannot sustain at extreme storage conditions for long time.

5. Electrical Specifications

5.1 Typical Electrical Characteristics

At Ta = 25 °C, VDD = 3V±5%, VSS=0V.

Table 5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (Logic)	VDD-VSS		2.85	3.0	3.15	V
Supply voltage (LCD) (Built-in)	VLCD =V0-VSS	Ta = -20 °C, VDD = +3V, Note 1	-	TBD	-	V
		Ta = +25 °C, VDD = +3V, Note 1	10.8	11.0	11.2	V
		Ta = +70 °C, VDD = +3V, Note 1	-	TBD	-	V
Low-level input signal voltage	V_{ILC}	Note 2	VSS	-	0.2xVDD	V
High-level input signal voltage	V_{IHC}	Note 2	0.8xVDD	-	VDD	V
Supply Current (Logic & LCD)	IDD	Character mode, VDD = +3V,Note 1	-	0.2	0.3	mA
		Checker board mode, VDD = +3V,Note 1	-	0.7	1.1	mA
Supply of voltage Yellow-green LED04 backlight	VLED	Forward current =140 mA (With externally current limiting resistors) Number of LED dies =28	3.8	4.1	4.4	V
Wavelength of Yellow-green LED04 backlight	λ		569	572	575	nm
Luminance of backlight (on the backlight surface)			75	100	-	cd/m^2

Note 1: There is tolerance in optimum LCD driving voltage during production and it will be within the specified range.

Note 2: Apply to A0, D0~D7, E/$\overline{RD}$, RW/$\overline{WR}$, $\overline{CS1}$, C86, P/S, and $\overline{RES}$.

5.2 Timing Specifications

Reset Input Timing

At Ta = -20 °C to +70 °C, VDD = +3V±5%, VSS = 0V.

Table 6

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t_R	Reset Time	-	-	1.0	µs	
t_{RW}	Reset low pulse width	10	-	-	µs	/RES

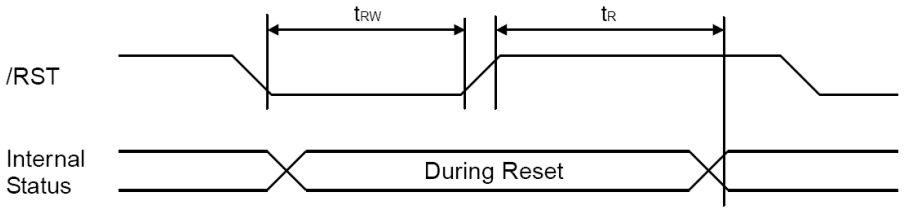


Figure 3: Reset Timing Diagram

System Buses Read/Write Characteristics (for 8080 Series MPU)

At Ta = -20 °C to +70 °C, VDD = +3V±5%, VSS = 0V.

Table 7

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
T_{AH8}	Address hold time	0	-	-	ns	A0
T_{AS8}	Address setup time	0	-	-	ns	
t_{CYC8}	System cycle time	240	-	-	ns	
t_{CCLW}	Control low pulse width (write)	90	-	-	ns	/WR
t_{CCLR}	Control low pulse width (read)	120	-	-	ns	/RD
t_{CCHW}	Control high pulse width (write)	100	-	-	ns	/WR
t_{CCHR}	Control high pulse width (read)	60	-	-	ns	/RD
T_{DS8}	Data setup time	40	-	-	ns	D0~D7
T_{DH8}	Data hold time	10	-	-	ns	
t_{ACC8}	/RD access time	-	-	140	ns	D0~D7, CL = 100pF
T_{CH8}	Output disable time	5	-	50	ns	

1. The input signal rise time and fall time (**tr**, **tf**) is specified at 15ns or less.
   (**tr** + **tf**) < (t_{CYC8} - t_{CCLW} - t_{CCHW}) for write, (**tr** + **tf**) < (t_{CYC8} - t_{CCLR} - t_{CCHR}) for read.
2. All timing is specified using 20% and 80% of VDD as the reference.
3. t_{CCLW} and t_{CCLR} are specified as the overlap interval when /CS1 is low (CS2 is high) and /WR or /RD is low.

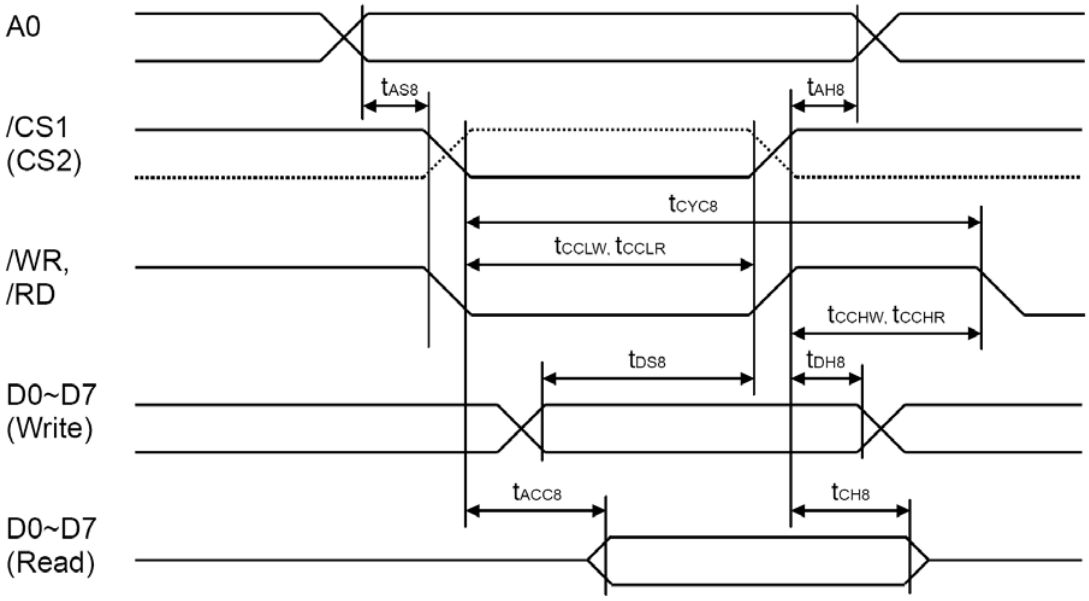


Figure 4: System Buses Read/Write Characteristics (for 8080 Series MPU)

System Buses Read/Write Characteristics (for 6800 Series MPU)

At Ta = -20 °C to +70 °C, VDD = +3V±5%, VSS = 0V.

Table 8

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t_{AH6}	Address hold time	0	-	-	ns	A0, R/W
t_{AS6}	Address setup time	0	-	-	ns	
t_{CYC6}	System cycle time	240	-	-	ns	
t_{EWHW}	Control high pulse width (write)	90	-	-	ns	E
t_{EWHR}	Control high pulse width (read)	120	-	-	ns	E
t_{EWLW}	Control low pulse width (write)	100	-	-	ns	E
t_{EWLR}	Control low pulse width (read)	60	-	-	ns	E
t_{DS6}	Data setup time	40	-	-	ns	D0~D7
t_{DH6}	Data hold time	10	-	-	ns	
t_{ACC6}	/RD access time	-	-	140	ns	D0~D7 CL = 100pF
t_{OH6}	Output disable time	5	-	50	ns	

1. The input signal rise time and fall time (**tr**, **tf**) is specified at 15ns or less.
   (**tr** + **tf**) < (t_{CYC6} - t_{EWLW} - t_{EWHW}) for write, (**tr** + **tf**) < (t_{CYC6} - t_{EWLR} - t_{EWHR}) for read.
2. All timing is specified using 20% and 80% of VDD as the reference.
3. t_{EWHW} and t_{EWHR} are specified as the overlap interval when /CS1 is low (CS2 is high) and E is high.

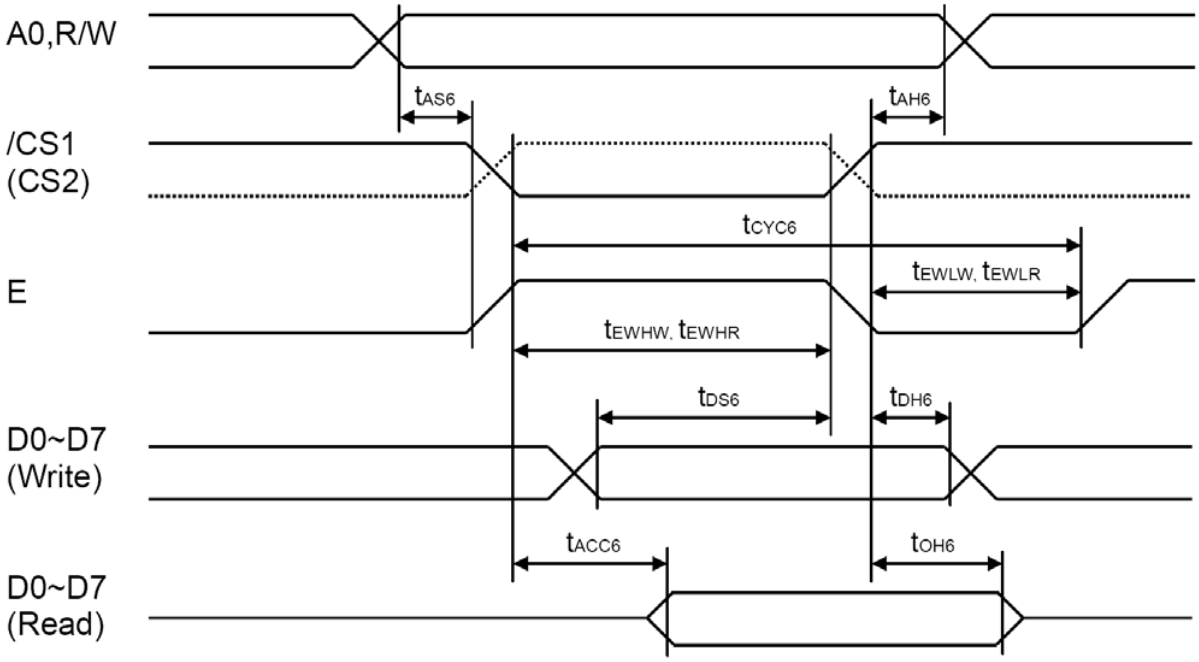


Figure 5: System Buses Read/Write Characteristics (for 6800 Series MPU)

5.3 Instruction Set

Table 9(a): Command table

Command	A0	/RD	/WR	Code									Function
				D7	D6	D5	D4	D3	D2	D1	D0	Hex	
(1) Display OFF	0	1	0	1	0	1	0	1	1	1	0 1	AEh AFh	Turn on LCD panel when high, and turn off when low
(2) Display Start Line Set	0	1	0	0	1	Display Start Address						40h to 7Fh	Specifies RAM display line for COM0
(3) Page Address Set	0	1	0	1	0	1	1	Page Address				B0h to B8h	Set the display data RAM page in Page Address register
(4) Column Address Set	0	1	0	0	0	0	1	Higher Column Address				00h to 18h	Set 4 higher bits and 4 lower bits of column address of display data RAM in register
	0	1	0	0	0	0	0	Lower Column Address					
(5) Read Status	0	0	1	Status				0	0	0	0	XX	Reads the status information
(6) Write Display Data	1	1	0	Write Data								XX	Write data in display data RAM
(7) Read Display Data	1	0	1	Read Data								XX	Read data from display data RAM
(8) ADC Select	0	1	0	1	0	1	0	0	0	0	0 1	A0h A1h	Set the display data RAM address SEG output correspondence
(9) Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	0 1	A6h A7h	Normal indication when low, but full indication when high
(10)Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	0 1	A4h A5h	Select normal display (0) or entire display on
(11)LCD Bias Set	0	1	0	1	0	1	0	0	0	1	0 1	A2h A3h	Sets LCD driving voltage bias ratio
(12)Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	E0h	Increments column address counter during each write
(13)End	0	1	0	1	1	1	0	1	1	1	0	EEh	Releases the Read-Modify-Write
(14)Reset	0	1	0	1	1	1	0	0	0	1	0	E2h	Resets internal functions
(15)Common Output Mode Select	0	1	0	1	1	0	0	0 1	*	*	*	C0h to CFh	Select COM output scan direction *: invalid data
(16)Power Control Set	0	1	0	0	0	1	0	1	Operation Status			28h to 2Fh	Select the power circuit operation mode
(17)V0 Voltage Regulator Internal Resistor ratio Set	0	1	0	0	0	1	0	0	Resistor Ratio			20h to 27h	Select internal resistor ratio Rb/Ra mode
(18)Electronic Volume mode Set	0	1	0	1	0	0	0	0	0	0	1	81h	
Electronic Volume Register Set	0	1	0	*	*	Electronic Control Value						XX	Sets the V0 output voltage electronic volume register
(19)Set Static indicator ON/OFF	0	1	0	1	0	1	0	1	1	0	0 1	ACh ADh	Sets static indicator ON/OFF 0: OFF, 1: ON
Set Static Indicator Register	0	1	0	*	*	*	*	*	*	Mode		XX	Sets the flash mode
(20)Power Save	0	1	0	-	-	-	-	-	-	-	-	-	Compound command of Display OFF and Entire Display ON
(21)NOP	0	1	0	1	1	1	0	0	0	1	1	E3h	Command for non-operation

Table 9(b): Command table

Command	A0	/RD	/WR	Code									Function
				D7	D6	D5	D4	D3	D2	D1	D0	Hex	
(22)Oscillation Frequency Select	0	1	0	1	1	1	0	0	1	0	0 1	E4h E5h	Select the oscillation frequency
(23)Partial Display mode Set	0	1	0	1	0	0	0	0	0	1	0 1	82h 83h	Enter/Release the partial display mode
(24)Partial Display Duty Set	0	1	0	0	0	1	1	0	Duty Ratio			30h 37h	Sets the LCD duty ratio for partial display mode
(25)Partial Display Bias Set	0	1	0	0	0	1	1	1	Bias Ratio			38h 3Fh	Sets the LCD bias ratio for partial display mode
(26)Partial Start Line Set	0	1	0	1	1	0	1	0	0	1	1	D3h	Enter Partial Start Line Set
Partial Start Line Set	0	1	0	1	1	Partial Start Line						XX	Sets the LCD Number of partial display start line
(27)N-Line Inversion Set	0	1	0	1	0	0	0	0	1	0	1	85h	Enter N-Line inversion
Number of Line Set	0	1	0	*	*	*	Number of Line					XX	Sets the number of line used for N-Line inversion
(28)N-Line Inversion Release	0	1	0	1	0	0	0	0	1	0	0	84h	Exit N-Line Inversion
(29)DC/DC Clock Set	0	1	0	1	1	1	0	0	1	1	0	E6h	Set DC/DC Clock Frequency
DC/DC Clock Division Set	0	1	0	1	1	0	0	Clock Division				XX	Set the Division of DC/DC Clock Frequency
(30)Test Command	0	1	0	1	1	1	1	*	*	*	*	F1h to FFh	IC test command. Do not use!
(31)Test Mode Reset	0	1	0	1	1	1	1	0	0	0	0	F0h	Command of test mode reset

Note: Do not use any other command, or system malfunction may result.

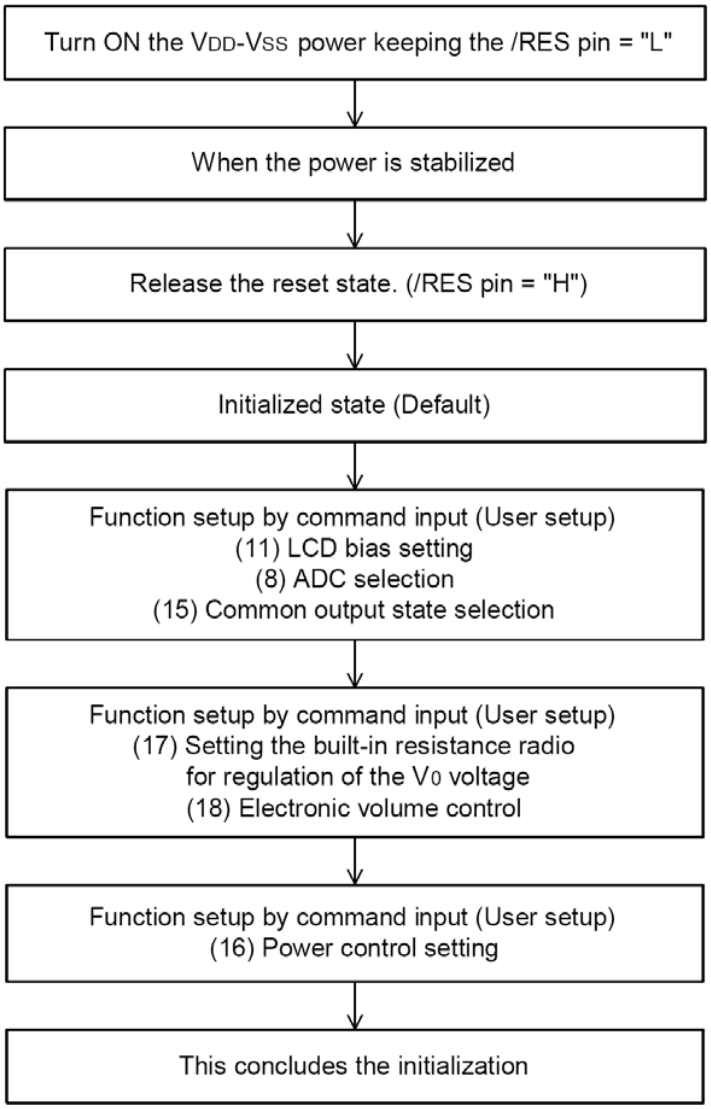
5.4 Command Description

Instruction Setup: Reference

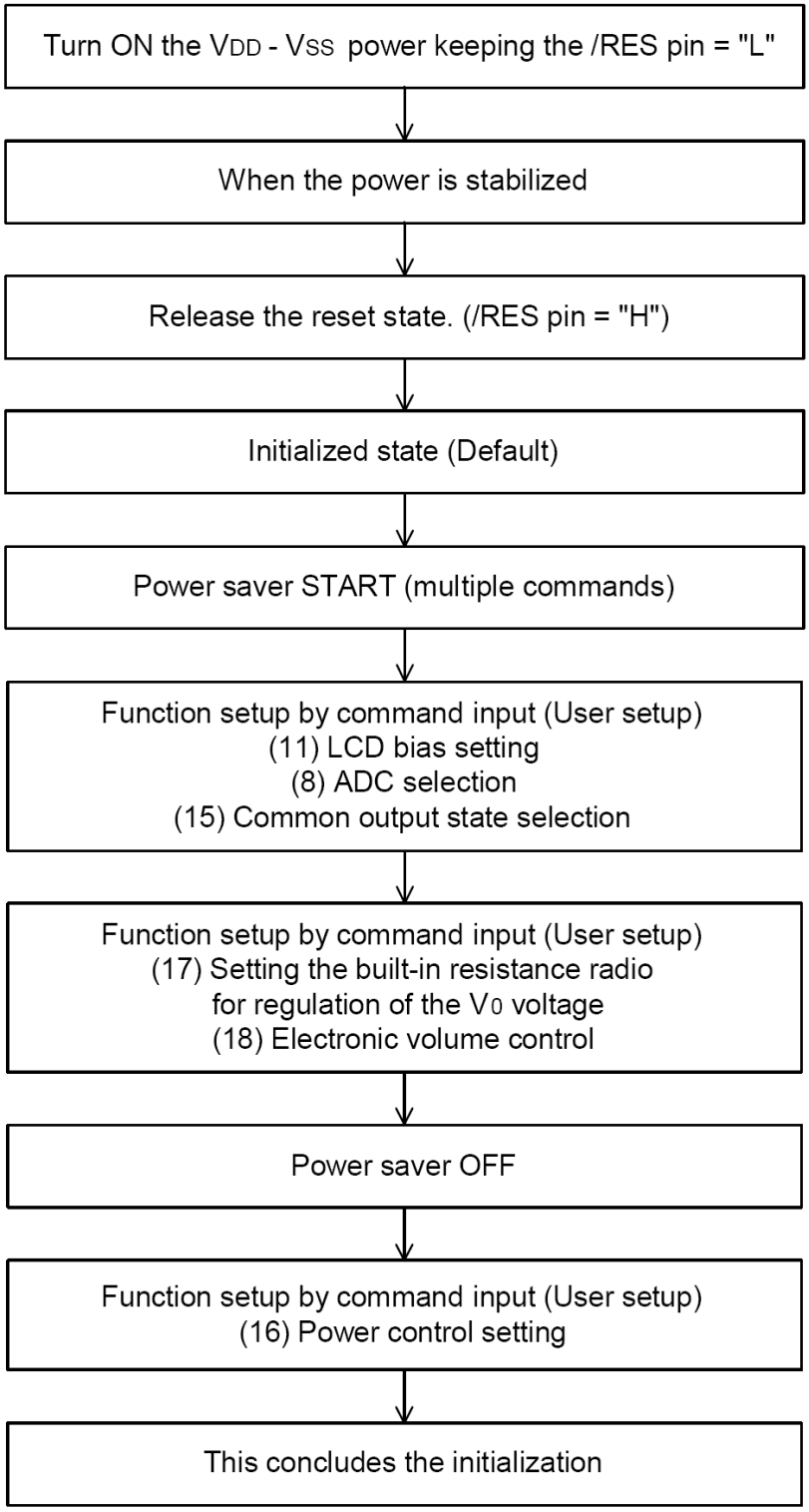
Initialization

Note: With this IC, when the power is applied, LCD driving non-selective potentials V2 and V3 (SEG pin) and V1 and V4 (COM pin) are output through the LCD driving output pins SEG and COM. When electric charge is remaining in the smoothing capacitor connecting between the LCD driving voltage output pins (V0 - V4) and the VDD pin, the picture on the display may instantaneously become totally dark when the power is turned on. To avoid such failure, we recommend the following flow sequence when turning on the power.

When the built-in power is being used immediately after turning on the power:



When the built-in power is not being used immediately after turning on the power:



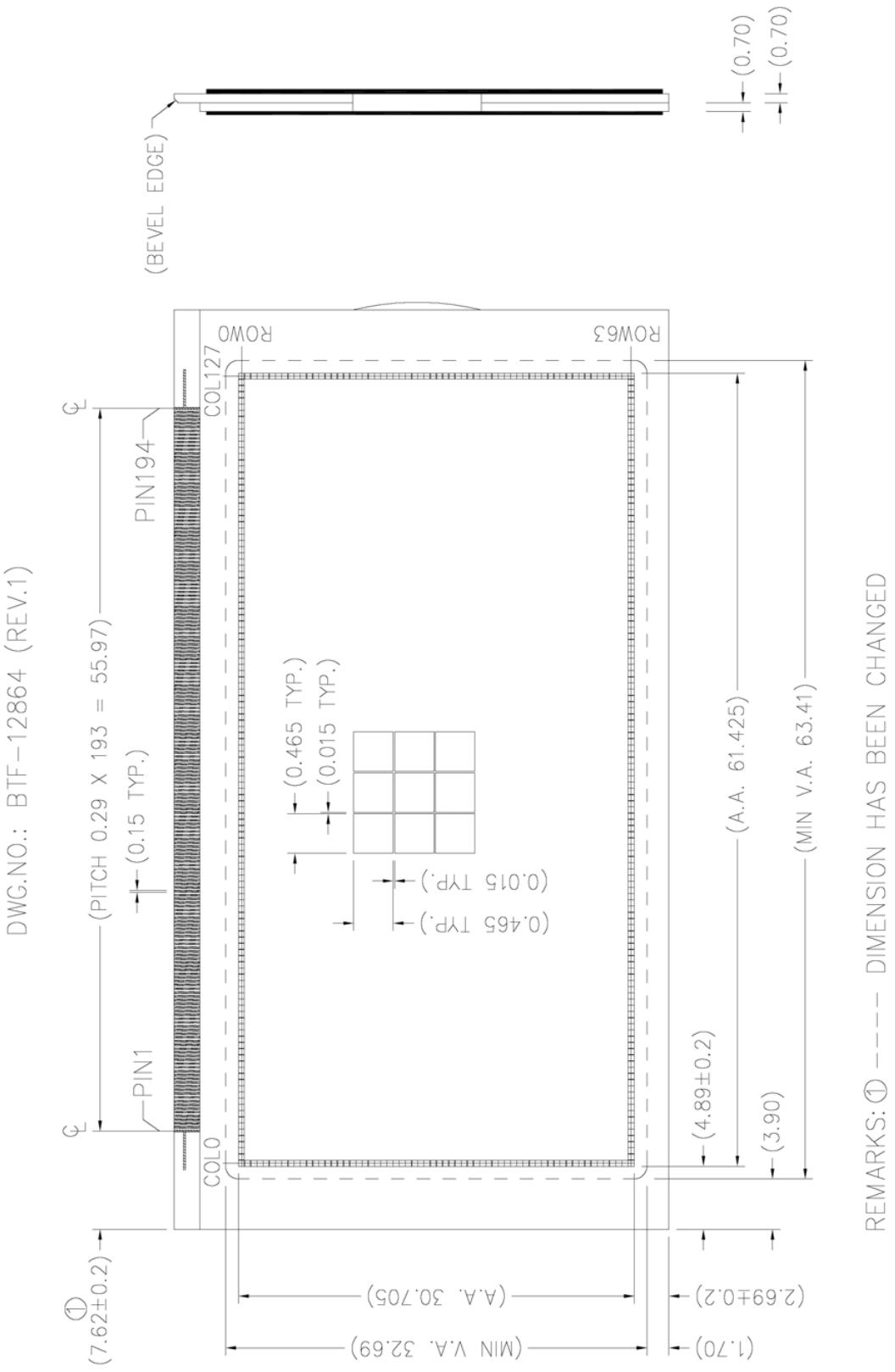


Figure 7: LCD Drawing 2

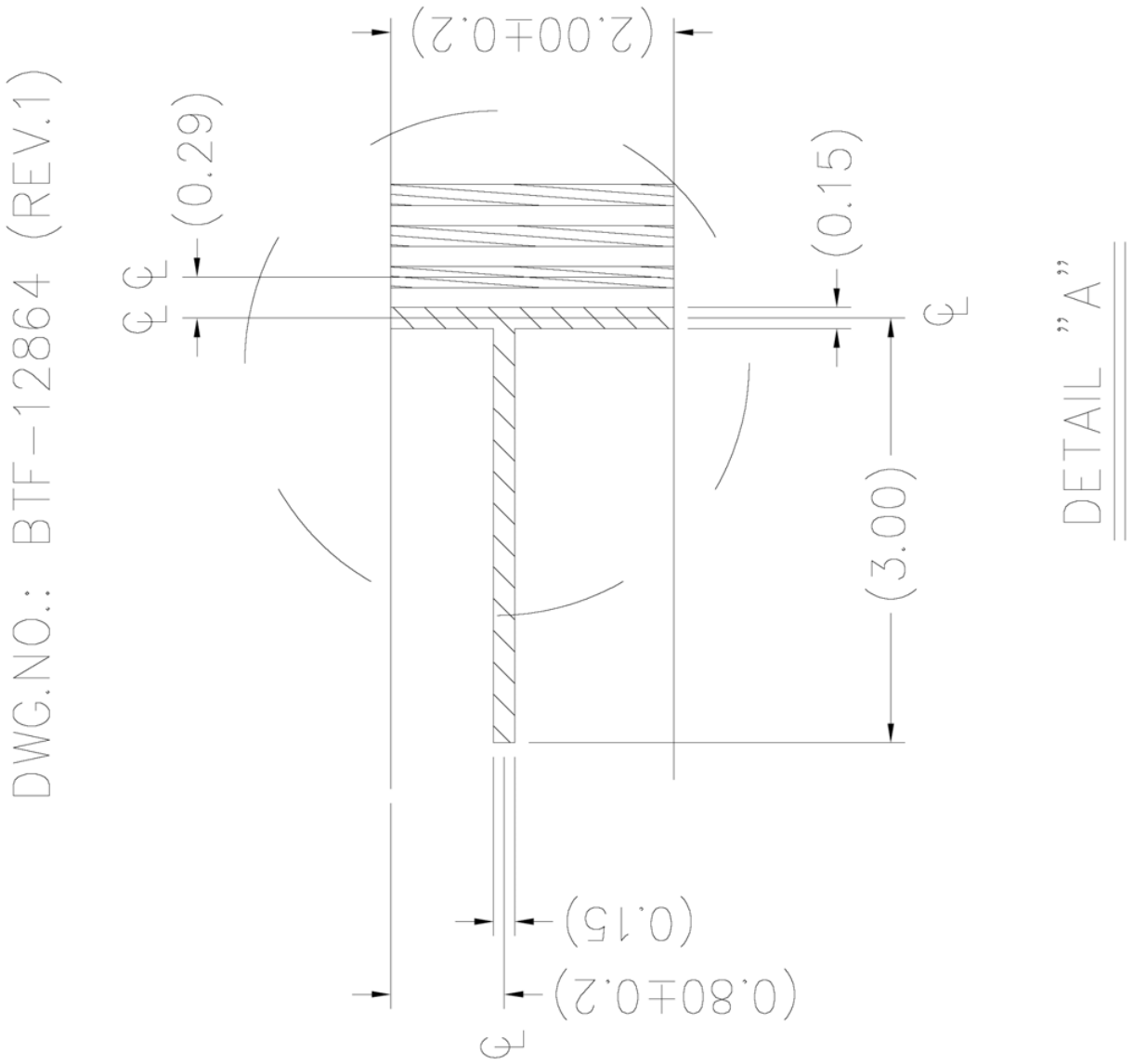


Figure 8: LCD Drawing 3

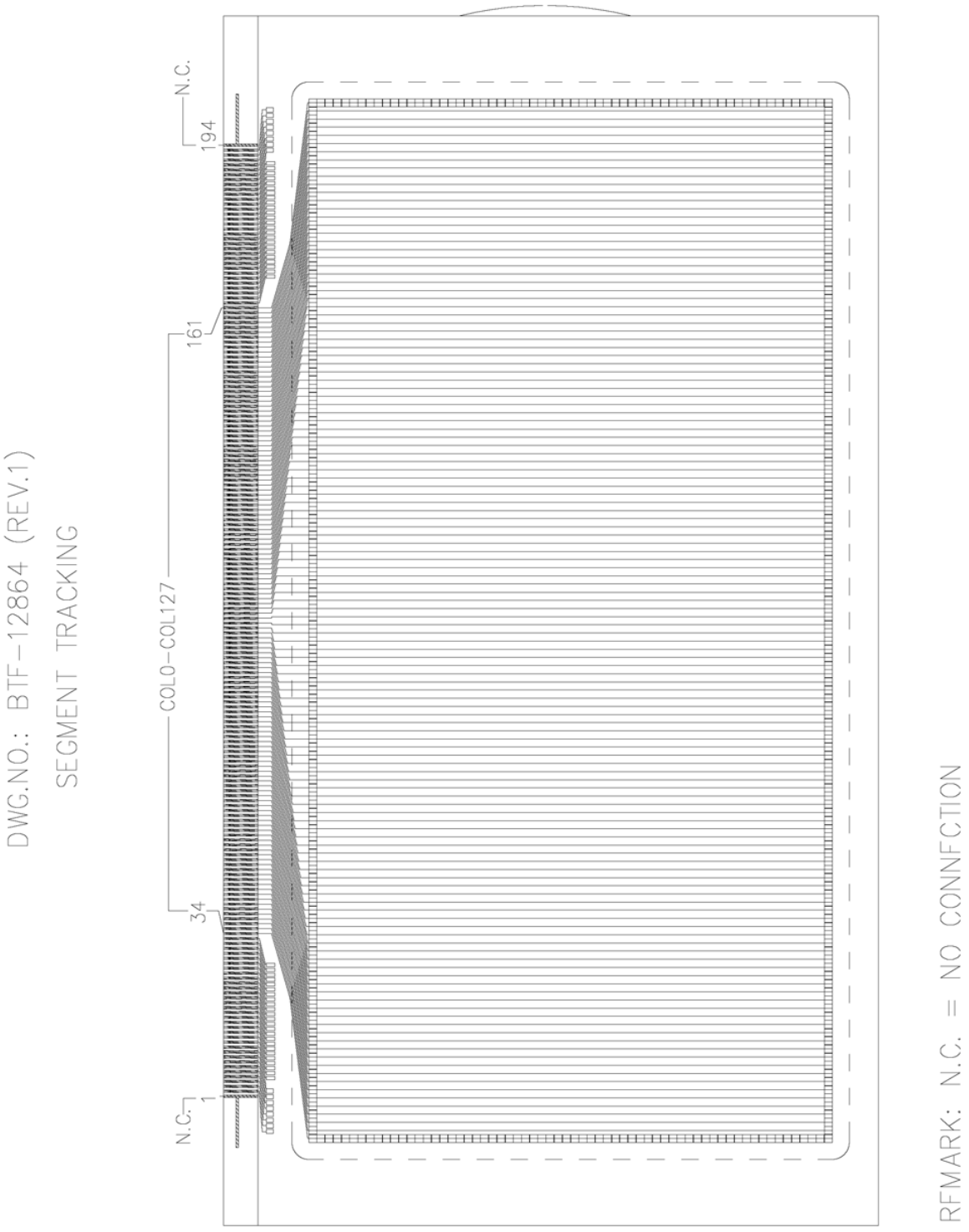


Figure 9: LCD Drawing 4

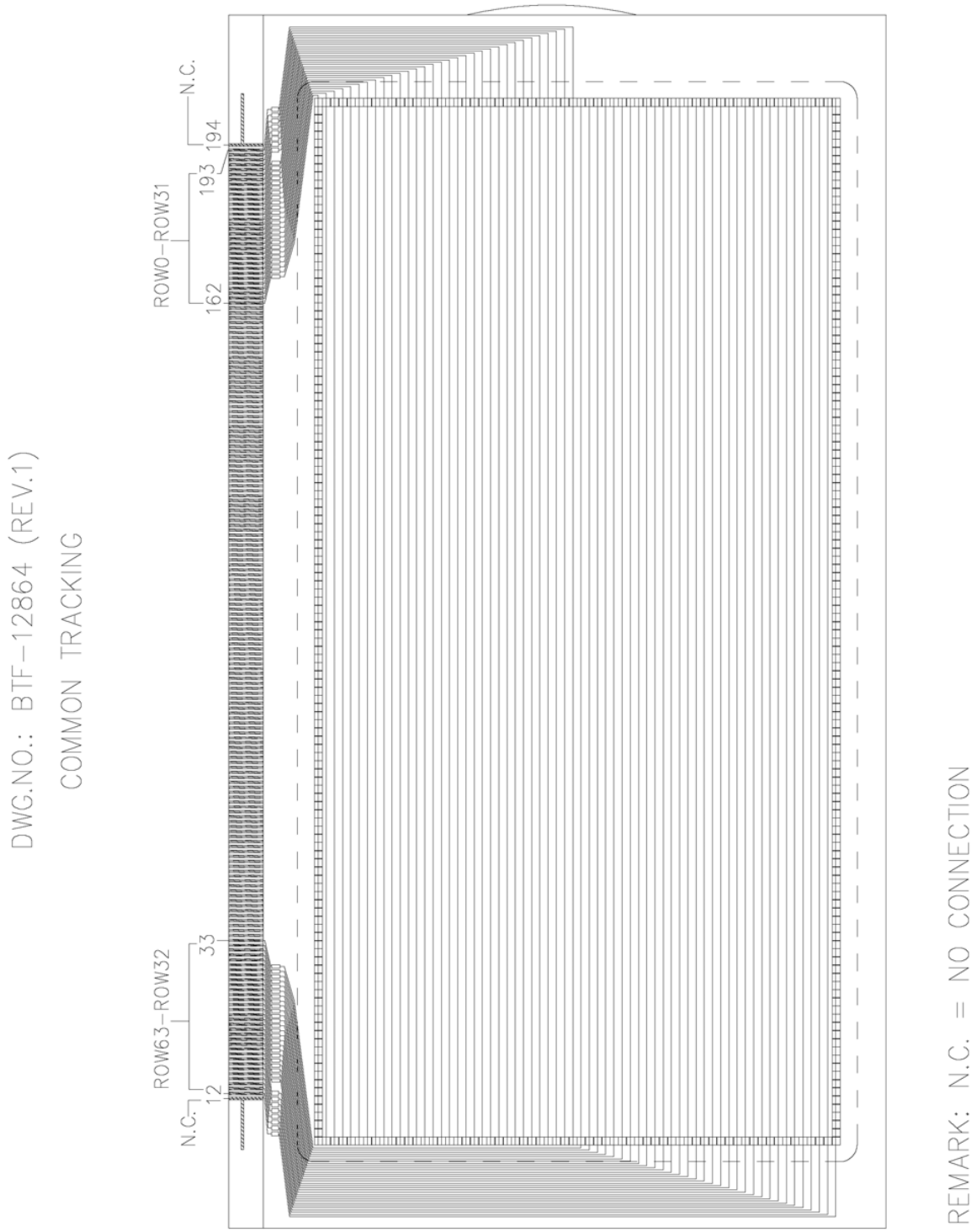


Figure 10: LCD Drawing 5

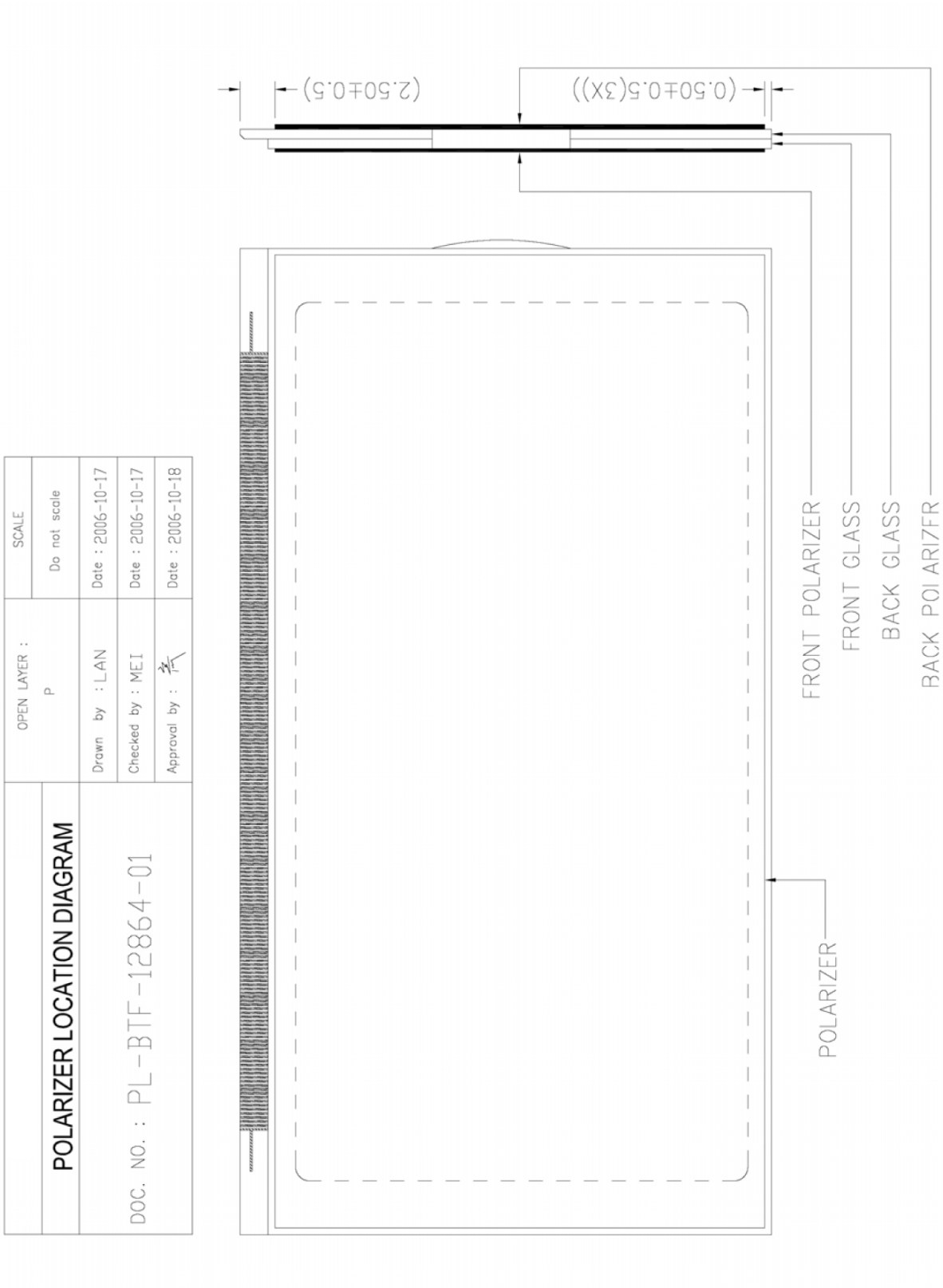


Figure 11: LCD Drawing 6

7. LCD Cosmetic Conditions

a.) Reference document follow VL-QUA-012B.

b.) LCD size of the product is small.

8. Remark

HANDLING LCD AND LCD MODULES

Liquid Crystal Display (LCD)

LCD is made up of glass, organic sealant, organic fluid and polymer based polarizer's. The following precautions should be taken when handling:

1. Keep the temperature within range for use and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or bubble generation. When storage for a long period over 40° C is required, the relative humidity should be kept below 60%.
2. Do not contact the exposed polarizer's with anything harder than an HB pencil lead. To clean dust off the display surface, wipe gently with cotton, chamois or other soft material soaked in petroleum benzin. Never scrub hard.
3. Wipe off saliva or water drops immediately. Contact with water over a long period of time may cause polarizer deformation or colour fading, while an active LCD with water condensation on its surface will cause corrosion of ITO electrodes.
4. PETROLEUM BENZIN is recommended to remove adhesives used to attach front/rear polarizer's and reflectors, while chemicals like acetone, toluene, ethanol and isopropyl alcohol will cause damage to the polarizer. Avoid oil and fats. Avoid lacquer and epoxies which might contain solvents and hardeners to cause electrode errosion. Some solvents will also soften the epoxy covering the DIL pins and thereby weakening the adhesion of the epoxy on glass. This will cause the exposed electrodes to erode electrochemically when operating in high humidity and condensing environment.
5. Glass can be easily chipped or cracked from rough handling, especially at corners and edges.
6. Do not drive LCD with DC voltage.
7. When soldering DIL pins, avoid excessive heat and keep soldering temperature between 260°C to 300°C for no more than 5 seconds. Never use wave or reflow soldering.

Liquid Crystal Display Modules (MDL)
Mechanical Considerations

MDL's are assembled and adjusted with a high degree of precision. Avoid excessive shocks and do not make any alterations or modifications. The following should be noted.

1. Do not tamper in any way with the tabs on the metal frame.
2. Do not modify the PCB by drilling extra holes, changing its outline, moving its components or modifying its pattern.
3. Do not touch the elastomer connector (conductive rubber), especially when inserting an EL panel.
4. When mounting a MDL make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
5. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels.

Static Electricity

MDL contains CMOS LSI's and the same precaution for such devices should apply, namely:

1. The operator should be grounded whenever he comes into contact with the module. Never touch any of the conductive parts such as the LSI pads, the copper leads on the PCB and the interface terminals with any part of the human body.
2. The modules should be kept in antistatic bags or other containers resistant to static for storage.
3. Only properly grounded soldering irons should be used.
4. If an electric screwdriver is used it should be well grounded and shielded from commutator sparks.
5. The normal static prevention measures should be observed for work clothes and working benches; for the latter conductive (rubber) mat is recommended.
6. Since dry air is inducive to statics, a relative humidity of 50 - 60% is recommended.

Soldering

1. Solder only to the I/O terminals.
2. Use only soldering irons with proper grounding and no leakage.
3. Soldering temperature is $280^0C \pm 10^0C$.
4. Soldering time: 3 to 4 seconds.
5. Use eutectic solder with resin flux fill.
6. If flux is used. the LCD surface should be covered to avoid flux spatters. Flux residue should be removed afterwards.
7. Use proper de-soldering methods (e.g. suction type desoldering irons) to remove lead wires from the I/O terminals when necessary. Do not repeat the soldering/ desoldering process more than three times as the pads and plated through holdes may be damaged.

Operation

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Driving voltage should be kept within specified range, excess voltage shortens display life.
3. Response time increases with decrease in temperature.
4. Display may turn black or dark Blue at temperatures above its operational range; this is however not destructive and the display will return to normal once the temperature falls back to range.
5. Mechanical disturbance during operation (such as pressing on the viewing area) may cause the segments to appear "fractured". They will recover once the display is turned off.
6. Condensation at terminals will cause malfunction and possible electrochemical reaction. Relative humidity of the environment should therefore be kept below 60%.

Storage

1. LCD's should be kept in sealed polyethylene bags while MDL's should use antistatic ones. If properly sealed, there is no need for desiccant.
2. Store in dark places and do not expose to sunlight or fluorescent light. Keep the temperature between 0^0C and 35^0C and the relative humidity low.

Safety

If any fluid leaks out of a damaged glass cell, wash off any human part that comes into contact with soap and water. Never swallow the fluid. The toxicity is extremely low but caution should be exercised at all time.

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