

PRODUCT SPECIFICATION

Part Number

PG12232D-O Series

CUSTOMER	
CUSTOMER PART NUMBER	
DESCRIPTION	
APPROVED BY	
DATE	



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Record of Revisions

Rev.	Comments	Page	Date
1	Preliminary Specification was first issued.	All	8/8'14



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1. Part number breakdown

Replace each Space (_) with the following letters and or numbers

1. P-tec LCD Type	C = Character G = Graphic COG = Chip On Glass	COF = Chip On Flex TAB = Tape Automated Bonding TFT = Thin-film Transistor		
2. LCD Model		2002A = 20 Characters x 2 Lines w/ Pins on Left side and 116mm x 37 x 12.7mm overall size 364B = 128 Dots per row x 64 Dots per Column w/ Pins on lower side and 93mm x 70 x 8.8mm overall size		
3. Fluid Type	T = TN/Grey Y = STN/Yellow Green G = STN/ Grey	B = STN/ BlueF = FSTN/ WhiteN = FSTN/ Black		
4. Backlight/polorizer	NF = None/Transflective NM= None/Transmissive NR=None/Reflective EF= EL/Transflective EM= EL/Transmissive	LF= LED/Transflective LM= LED/Transmissive CF= CCFL/Transflective CM=CCFL=Transmissive		
5. Backlight Color	(If no backlight provided B = Blue/Green Y = Yellow G = Green	move on to viewing angle [6.]) \$ = Yellow/Green O = Orange W = White		
6. Viewing Angle	D = 6:00 U = 12:00	R = 3:00 L = 9:00		
7. Internal Number	Single Letter for internal p	Single Letter for internal purposes		
8. Extended Temperature	This space is blank if operating temperature is standard 0°C to 50°C An X will be visible if the LCD is Extended operating temperature			
Customer Specials or List of Value-added items	Usually blank unless customer requests some modifications. Can be several Letters long.			



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2. Precautions in use of LCD Modules

- (1)Avoid applying excessive shocks to the module or making any alterations or modifications to it.
- (2)Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
- (3)Don't disassemble the LCM.
- (4)Don't operate it above the absolute maximum rating.
- (5)Don't drop, bend or twist LCM.
- (6) Soldering: only to the I/O terminals.
- (7)Storage: please storage in anti-static electricity container and clean environment.

3. General Specification

Item	Dimension	Unit		
Number of Dots	122 x 32	_		
Module dimension(With LED Backlight)	65.8 x 27.0 x 12.0 (MAX)	mm		
View area	60.2 x 18.0	mm		
Active area	53.64 x 14.04	mm		
Dot size	0.45 x 0.40	mm		
Dot pitch	0.49 x 0.44	mm		
LCD type	STN			
Duty	1/32			
View direction	6 o'clock or 12 o'clock			
Backlight Type	WHITE BACKLIGHT			



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4. Absolute Maximum Ratings

Item		Symbol	Min	Max	Unit
Input Voltage		V_{I}	-0.3	VDD+0.3	V
Supply Voltage For l	Logic	$VDD-V_{SS}$	-0.3	7.0	V
Supply Voltage For I	LCD	V_{DD} - V_0	Vdd-13.5	0	V
Standard	Operating Temp.	Тор	0	50	$^{\circ}\!\mathbb{C}$
Temperature LCM	Storage Temp.	Tstr	-10	60	$^{\circ}\!\mathbb{C}$
Wide Temperature	Operating Temp.	Тор	-20	70	$^{\circ}\mathbb{C}$
LCM	Storage Temp.	Tstr	-30	80	$^{\circ}\mathbb{C}$

5. Electrical Characteristics

Item	Symbol	Condition	Min	Тур	Max	Unit
Supply Voltage For Logic	V_{DD} - V_{SS}	_	4.5	5.0	5.5	V
Supply Voltage For LCD	V_{DD} - V_0	Ta=25 ℃	-	4.8	-	V
Input High Volt.	$V_{ m IH}$	_	$0.7~\mathrm{V_{DD}}$	_	V_{DD}	V
Input Low Volt.	$ m V_{IL}$	_	V_{SS}	_	$0.3~\mathrm{V_{DD}}$	V
Supply Current	I_{DD}	V _{DD} =5V	-	1.0	2.0	mA
Supply Voltage of backlight	V_{LED}	Forward current =15 mA	-	3.2	-	V



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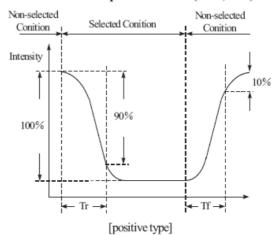
6. Optical Characteristics

Item	Symbol	Condition	Min	Тур	Max	Unit
View Angle	(V)θ	CR≧2	-20	_	35	deg
, ie w i migie	(Н)ф	CR≧2	-30	_	30	deg
Contrast Ratio	CR	_	_	3		_
Response Time	T rise	_	_	_	250	ms
Treesponde Timbe	T fall	_	_	-	250	ms

Definition of Operation Voltage (Vop)

Intensity Non-selected Wave Non-selected Wave Non-selected Wave Cr Max Vop Driving Voltage(V) [positive type]

Definition of Response Time (Tr, Tf)

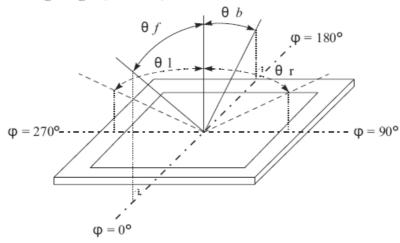


Conditions:

Operating Voltage : Vop Viewing Angle(θ , ϕ) : 0° , 0°

Frame Frequency: 64 HZ Driving Waveform: 1/N duty, 1/a bias

Definition of viewing angle($CR \ge 2$)





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7. Interface Pin Function

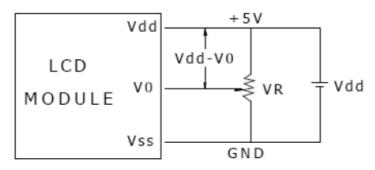
Pin No.	Symbol	Level	Description
1	RS	H/L	Register Select
2	E2	H/L	Enable For Chip2, Active High, Left Part
3	E1	H/L	Enable For Chip1, Active High, Left Part
4,5	NC	NC	NC
6	RW	H/L	Read/Write
7	V_{SS}	0V	Ground
8	DB0	H/L	Data bit 0
9	DB1	H/L	Data bit 1
10	DB2	H/L	Data bit 2
11	DB3	H/L	Data bit 3
12	DB4	H/L	Data bit 4
13	DB5	H/L	Data bit 5
14	DB6	H/L	Data bit 6
15	DB7	H/L	Data bit 7
16	V_{DD}	5.0V	Supply Voltage for logic
17	RSE	H/L	Reset Signal
18	V0		Operating voltage for LCD
19	NC	NC	NC
20	NC	NC	NC



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8. POWER SUPPLY

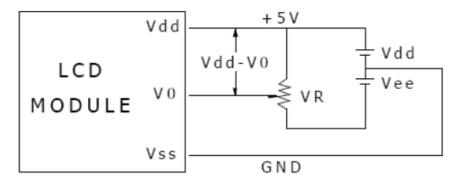
SINGLE SUPPLY VOLTAGE TYPE (for LCM with Negative Power on PCB)



Vdd-V0: LCD Driving Voltage

VR: 10K - 20K

DUAL SUPPLY VOLTAGE TYPE (for LCM without Negative Power on PCB)



Vdd-V0: LCD Driving Voltage

VR: 10K - 20K



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9. Contour Drawing & Block Diagram LED B/L -8.0±0.8+ 27.00±0.5 —23.40 —18.0 [V.A.] — —15.60 [A.A.] — 122X32 Dots 53.64[A.A.] 2.89 60.2 [V.A.] 65.80±0.5 5.00 1.30 2.00-6.00 21.90 22,00 VDD VSS LCD PANEL 122 X 32 DOTS 16 -0.40RS V0 RST 61 61 E1 E2 SED1520 D0A** SED1520 D0A** R/W DB0~ 0.04 DB7 ** OR EQUIVALENT



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10.Timing Characteristics

- AC Characteristics
- o Read/Write timing for the 80-port MPU

 $(T_a = -20 \text{ to } 75^{\circ}\text{C}, \text{Vss} = -5.0\text{V} \pm 10\%)$

Parameter	Signal	Symbol	Condition	Rating			Unit
raiametei	Signal	Signal Symbol Condition	Min	Тур	Max	Offic	
Address hold time	A0, CS	tahb		10	_	_	ns
Address set-up time	AU, CS	tawb		20	_	_	ns
System cycle time	WR, RD	tcycs		1000	_	_	ns
Control pulse width	WK, KD	tcc		200	_	_	ns
Data set-up time		tosa		80	_	_	ns
Data hold time	D0 ~ D7	tDH8		10	_	_	ns
RD access time	00~01	taccs	C _L = 100pF	_	_	90	ns
Output disable time		tонв	OL - 100pi	10	_	60	ns

^{*2.} The ratings when Vss = -3.0V are approximately 100% higher than when Vss = -5.0V.

o Read/Write timing for the 68-port MPU

 $(T_a = -20 \text{ to } 75^{\circ}\text{C}, \text{Vss} = -5.0\text{V} \pm 10\%)$

Daramete	Darameter Signa		Parameter Signal S	Cumbal	Condition		Rating		
Paramete	=1	Signal	Symbol	Condition	Min	Тур	Max	Unit	
System cycle tim	ne	A0, CS	toyee *3		1000	_	_	ns	
Address set-up ti	ime	R/W	tawe		20	_	_	ns	
Address hold tim	ne	I NVV	tане		10		_	ns	
Data set-up time			tose		80	_	_	ns	
Data hold time		D0 ~ D7	tоне		10	_	_	ns	
Output disable tii	me	00~07	tоне	CL = 100pF	10	_	60	ns	
Access time			tacce	OL - TOOPI	_	_	90	ns	
Enable pulse	READ	Е	tew		100	_	_	ns	
width	WRITE		tew		80	_	_	ns	

^{*3.} tcycs indicates the cycle during which CS/E are HIGH; it does not indicate the cycle of the E signal.

Control timing for 80-port/68-port display

 $(T_a = -20 \text{ to } 75^{\circ}\text{C}, \text{Vss} = -5.0\text{V} \pm 10\%)$

Parameter	Signal	al Symbol	Condition		Unit		
rarameter	Signal	Symbol	Condition	Min	Тур	Max	Offic
LOW pulse width		twlcl		35	_	_	μs
HIGH pulse width	CL	twncl		35	_	_	μs
Rising time	OL.	tr		_	30	150	ns
Falling time		tf		_	30	150	ns
FD delay time	FR	torr	(Input timing)	-2.0	0.2	2.0	116
FR delay time FR	110	LUFK	(Output timing), CL = 100pF	_	0.2	0.4	μs

^{*5.} The ratings when Vss = -3.0V are approximately 100% higher than when Vss = -5.0V.

^{*4.} The ratings when Vss = -3.0V are approximately 100% higher than when Vss = -5.0V.

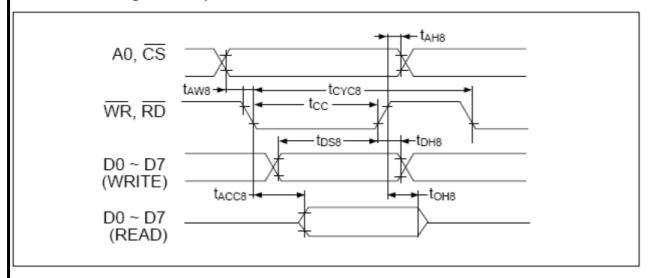
^{*6.} The input timing of the FR delay time is determined by the SED1520 (Slave). The output timing of the FR delay time is determined by the SED1520 (Master).



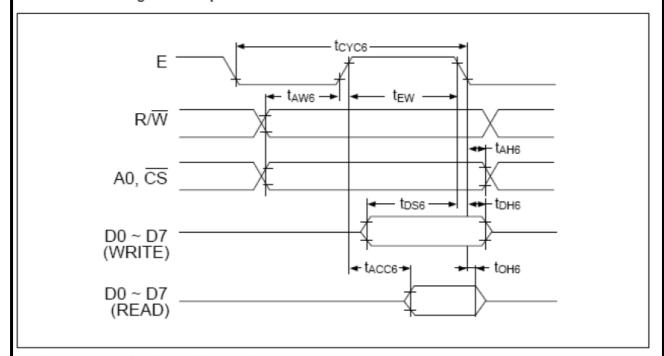
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Timing Chart

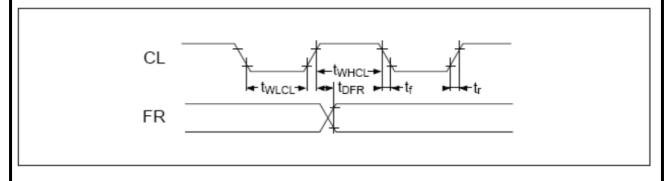
Read/Write timing for the 80-port MPU



o Read/Write timing for the 68-port MPU



o Control timing for 80-port/68-port display





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11.Instruction Table

■ DISPLAY COMMANDS (Based on the 80-port MPU; the RD and WR commands differ for the 68-port MPU.)

6 Write Display Data 1 0 1 Write Data bus to RAM previously-specified address of the Display RAM after which the column according to the Read Data RAM onto the data bus. 8 ADC Select 1 0 0 1 0 1 0 0 0 0 0/1RAM's column addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output Selects normal display operation or static all-lit drive Selects normal display operation.		Command RDWR AD D7 D6 D					D5 D4 D3 D2 D1 D0				D1	D0	Function		
Display START Line Display START Determines the line of RAM data to be displayed at the line o	1	Display ON/OFF	4	٥	n	1	٥	1	٥	1	1	1	0/1	Switches the entire display O	N or OFF, regardless of the
2 Line	Ľ	Display ON/OFF	Ľ	U	U	_	0		0				0/1	Display RAM's data or the i	nternal status. *7
Line Address (0-31) display's top line (COMO).	2	Display START	1	٥	n	1	1	n	Dis	pla	ıy S	STA	RT	Determines the line of RAM	I data to be displayed at the
4 Column (Segment) Address Set 1 0 0 0 Column address (0~79) Reads the status. BUSY 1: Busy (internal processing) 0: READY status Read 1 0 1 0 1 0 1 0 1 0 1 0 0 0 0 0 0 0 0	_	Line	Ľ		_	Ľ		_	ado	dre	SS	(0~	31)	display's top line (COM0).	
4 Column (Segment) 1 0 0 0 Column address Set	3	Page Address Set	1	0	0	1	0	1	1	1	0		_		y RAM in the page address
Address Set Co-79 address register.	Ĺ	_		_		Ĺ	_	_	_	_	_	_	-		
Reads the status. Status Read	4		1	0	0	0		Col				es	S		ne Display RAM in the column
Status Read 0 1 0 1 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Address Set							(0	~7	9)				
Status Read O 1 0 D D D D D D D D D D D D D D D D D D		Status Read		1				ш	SET				0		
ON/OFF 1: Display OFF 0: Display ON RESET 1: Resetting 0: Normal Write Display Data 1 0 1 Write Data Writes the data on the data bus to RAM Read Display Data 0 1 1 Read Data Read Data Reads data from the Display address of the Display RAM onto the data bus. Write Data Read Data Reads data from the Display address of the Display RAM onto the data bus. Used to reverse the correspondence between the Display RAM scolumn addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output ON/OFF Satisfic Drive ON/OFF												0		BUSY 1: Busy (internal pr	ocessing) 0: READY status
ON/OFF 1: Display OFF 0: Display ON RESET 1: Resetting 0: Normal Write Display Data 1 0 1 Write Data Writes the data on the data bus to RAM Read Display Data 0 1 1 Read Data Read Data Reads data from the Display address of the Display RAM onto the data bus. Write Data Read Data Reads data from the Display address of the Display RAM onto the data bus. Used to reverse the correspondence between the Display RAM scolumn addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output ON/OFF Satisfic Drive ON/OFF	5		ln		0	lSΥ	8	ē		0	0			ADC 1: Rightward (forw	ard) output
RESET 1: Resetting 0: Normal Write Display Data 1 0 1 Write Data Write the data on the data bus to RAM Read Display Data 0 1 1 Read Data RAM onto the data bus. These commands access previously-specified address of the Display RAM after which the column at dress is incremented by on 0: Rightward (forward) output 1: Leftward (reverse) output por 0: Rightward (forward) output 1: Leftward (reverse) output por 0: Rightward (forward) output 1: Leftward (reverse) output por 0: Rightward (forward) output 1: Leftward (reverse) output por 0: Rightward (forward) output 1: Leftward (reverse) output por 0: Rightward (forward) output 1: Leftward (reverse) output por 0: Rightward (forward) output 1: Leftward (reverse) output display operation. 10 Duty Select 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0	ľ		ľ			BU	¥ ;	Š	R	Ľ.	Ü	·		0: Leftward (revers	se) output
Write Display Data 1 0 1 Write Data Writes the data on the data bus to RAM Read Display Data 0 1 1 Read Data Read Data Read Data Read Sata from the Display address of the Display RAM after which the column as dress is incremented by on 0: Rightward (forward) output 1: Leftward (reverse) output Select Drive ON/OFF Duty Select 1 0 0 1 0 1 0 1 0 0 0 0 0 0/1 RAM's column addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output Selects normal display operation or static all-lit drive 10 Duty Select 1 0 0 1 0 1 0 1 0 0 0 0 0 0/1 RAM's column addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output Selects normal display operation or static all-lit drive 10 Duty Select 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0								_						ON/OFF 1: Display OFF	0: Display ON
bus to RAM previously-specified address of the Display RAM Read Data Read Data Reads data from the Display address of the Display RAM address of the Display RAM RAM onto the data bus. Read Display Data 1														RESET 1: Resetting	0: Normal
Bust to RAM previously-specified address of the Display Address of the Display RAM after which the column address is incremented by on Used to reverse the correspondence between the Display ADC Select 1 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	6	Write Display Data	1	0	1			w	rite	Da	nta			Writes the data on the data	These commands access a
Read Display Data 0 1 1 Read Data RAM onto the data bus. after which the column and dress is incremented by on Used to reverse the correspondence between the Display Barbor Select Drive ON/OFF 1 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0	Ľ	Write Display Data	'	J	_'			**	IIIC	De	ita			bus to RAM	previously-specified
dress is incremented by on Used to reverse the correspondence between the Displa ADC Select 1 0 0 1 0 1 0 0 0 0 0 0/1RAM's column addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output Selects normal display operation or static all-lit drive ON/OFF 1 0 0 1 0 1 0 1 0 0 0/1 display operation. 1: Static drive (Power Save) *7 0: Normal display operation 1: Selects the duty factor for driving LCD cells. 1: 1/32 duty 0: 1/16 duty Increments the column address counter by one only whe display data is written but not when it is read. Reset 1 0 0 1 1 1 1 0 0 1 1 0 0 Resets the Column address counter to 0 and page														Reads data from the Display	address of the Display RAM,
Used to reverse the correspondence between the Displa ADC Select 1 0 0 1 0 1 0 0 0 0 0 0/1RAM's column addresses and segment driver output por 0: Rightward (forward) output 1: Leftward (reverse) output Selects normal display operation or static all-lit drive ON/OFF 1 0 0 1 0 1 0 1 0 0 0 0/1 Selects the duty factor for driving LCD cells. 1: 1/32 duty 1 Read Modify Write 1 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0	7	Read Display Data	0	1	1			Re	ead	Da	ıta			RAM onto the data bus.	after which the column ad-
ADC Select 1 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0															dress is incremented by one.
ON/OFF Static Drive ON/OFF 1 0 0 1 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0		ADC Select		0	0			1					0/1		
Static Drive ON/OFF 1 0 0 1 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 1 0 0 0 1 0	8		1			1	0		0	0	0	0		RAM's column addresses and	d segment driver output ports
9 ON/OFF 1 0 0 1 0 1 0 0 1 0 0 1 0 0/1 display operation. 1: Static drive (Power Save) *7 0: Normal display operation. 1: Static drive (Power Save) *7 0: Normal display operation. 1: Static drive (Power Save) *7 0: Normal display operation. 1: J/32 duty 0: 1/16 duty 1: J/32 duty 0: J/16 duty 1: J/32 duty 0: J/32 duty 1: J/32 dut														0: Rightward (forward) output	1: Leftward (reverse) output
9 ON/OFF 1 0 0 1 0 1 0 1 0 0 1 0 0/1display operation. 1: Static drive (Power Save) *7 0: Normal display operation 10 Duty Select 1 0 0 1 0 1 0 1 0 0 0/1 Selects the duty factor for driving LCD cells. 1: 1/32 duty 0: 1/16 duty 11 Read Modify Write 1 0 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0		Static Drive												Selects normal display ope	ration or static all-lit drive
10 Duty Select 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0	9		1	0	0	1	0	1	0	0	1	0	- 1	display operation.	
10 Duty Select 1 0 0 1 0 1 0 1 0 0 0 0 1 1: 1/32 duty 1:														1: Static drive (Power Save) *7	0: Normal display operation
1: 1/32 duty 0: 1/16 duty 11 Read Modify Write 1 0 0 1 1 1 0 0 0 0 0 0 Increments the column address counter by one only whe display data is written but not when it is read. 12 End 1 0 0 1 1 1 0 0 1 1 1 0 Cancels the Ready Modify Write mode. Resets the Display START line to the 1st line in the register. 13 Reset 1 0 0 1 1 1 0 0 0 1 0 Resets the column address counter to 0 and page	10	Duty Select	1	Ω	n	1	0	1	٥	1	Ω	Ω	0/1	Selects the duty factor for d	Iriving LCD cells.
11 Read Modify Write 1	-	Daty Ociect	Ľ	J	J	Ľ	0		0		-		0/1	1: 1/32 duty	0: 1/16 duty
display data is written but not when it is read. 12 End 1 0 0 1 1 1 0 0 1 1 1 0 Cancels the Ready Modify Write mode. Resets the Display START line to the 1st line in the register. 13 Reset 1 0 0 1 1 1 0 0 0 1 0 Resets the column address counter to 0 and page	11	Read Modify Write	1	0	n	1	1	1	0	n	n	n	n	Increments the column addre	ss counter by one only when
Resets the Display START line to the 1st line in the register. 13 Reset	Ľ	Toda Woully Wille	Ľ			Ľ				_				display data is written but n	ot when it is read.
13 Reset 1 0 0 1 1 1 0 0 0 1 0 Resets the column address counter to 0 and page	12	End	1	0	0	1	1	1	0	1	1	1	0	Cancels the Ready Modify	Write mode.
		Reset			0									Resets the Display START line	to the 1st line in the register.
address register to 3.	13			0		1	1	1	0	0	0	1	0	Resets the column address	counter to 0 and page
														address register to 3.	

^{*7.} Power Save mode is entered by selecting static drive in Display OFF status.



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12.Quality Assurance

Screen Cosmetic Criteria

Item	Defect	Judgment Criterion	Partition
1	Spots	A)Clear	Minor
2	Bubbles in Polarizer		Minor
3	Scratch	In accordance with spots cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
4	Allowable Density	Above defects should be separated more than 30mm each other.	Minor
5	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-light type should be judged with back-light on state only.	Minor



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13.Reliability

Content of Reliability Test

Environmental	Test							
Test Item	Content of Test	Test Condition	Applicable Standard					
High Temperature storage	Endurance test applying the high storage temperature for a long time.	60℃ 96hrs						
Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10℃ 96hrs						
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50°C 96hrs						
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0℃ 96hrs						
High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	60℃,90%RH 96hrs						
High Temperature/ Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	50℃,90%RH 96hrs						
Temperature Cycle	Endurance test applying the low and high temperature cycle. -10°C 25°C 60°C 30min 5min 30min 1 cycle	-10°C/60°C 10 cycles						
Mechanical Test								
Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs						
Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msedc 3 times of each direction						

^{***}Supply voltage for logic system=5V. Supply voltage for LCD system=Operating voltage at 25° C