

LIQUID CRYSTAL DISPLAY MODULE

Standard Product Specification

PRODUCT NUMBER	LR2128
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Product Mgr	Quality Mgr	Electrical Eng	Document Control
Date:	Date:	Date:	Date:

- Approval for Specification only**
- Approval for Specification and Sample**

Sample no.:

Date:

ISIR no.:

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	LAF1614	REV. 1.0

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
A	02/17/06	--	--	Initial DCA Release.	E2096

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1 MAIN FEATURES

UNIT=MM

ITEM		CONTENTS
Display Format		1-line 16-character display
Colour		Monochrome
Overall Dimensions		122.2 (W) x 33.2 (H) x 11.3 (D) Max (EL version w/o NVTC)
Viewing Area		99.0 (W) x 13.0 (H)
LCD Type		STN
Mode		Reflective \ Transflective - Positive
Viewing Angle		12:00
Duty Ratio		1/16
Driver IC		ST7066U
Backlight Type \ Colour		EL \ Blue Green
DC/DC Converter		Built-In
Operating Temperature	Normal	0°C~+50°C
	Wide	-20°C~+70°C
Storage Temperature	Normal	-20°C~+70°C
	Wide	-30°C~+80°C
RoHS Compliant		Yes

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2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	1-line 16-character display	
Overall Dimensions	122.2 (W) x 33.2 (H) x 11.3 (D) Max (EL version w/o NVTC)	mm
Viewing Area	99.0 (W) x 13.0 (H)	mm
Active Area	94.84 (W) x 9.66 (H)	mm
Character Size	4.84 (W) x 8.06 (H)	mm
Character Pitch	6.00 (W) x 8.56 (H)	mm
Dot Size	0.92 (W) x 1.1 (H)	mm
Dot Pitch	0.98 (W) x 1.16 (H)	mm
IC Controller/Driver	ST7066U	

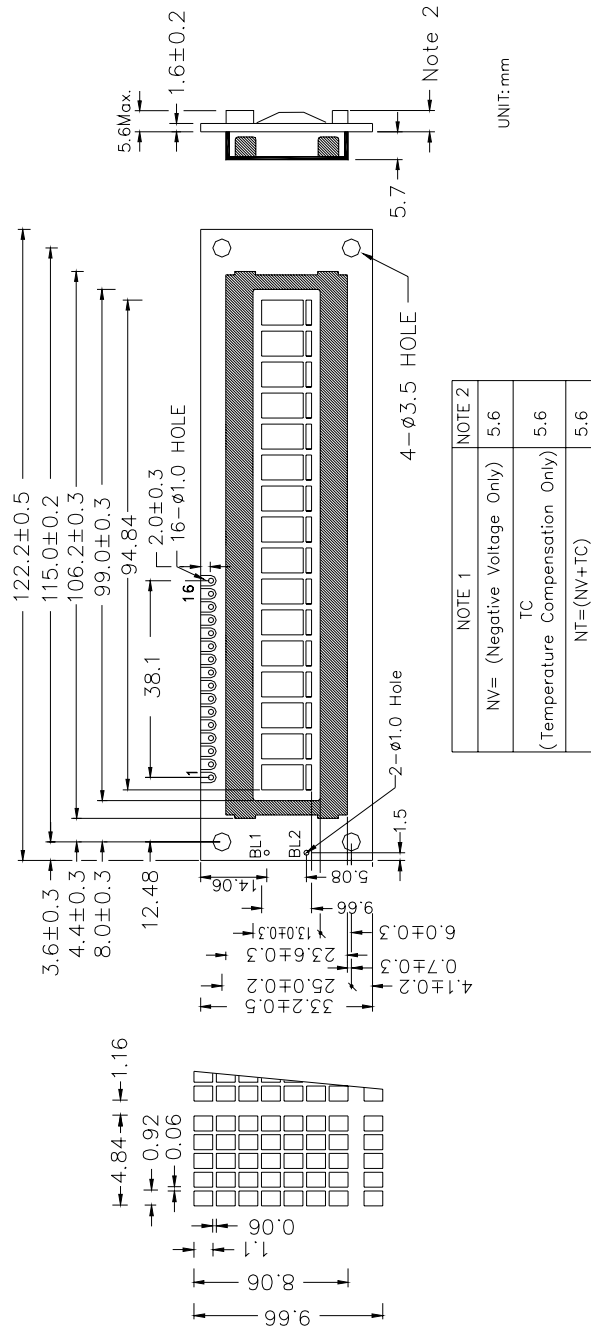
2.2 LABELLING & MARKING

DENSITRON LR2128 TAIWAN YYYYMM

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2.3 MECHANICAL DRAWING



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3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note	
Power Supply Voltage	V _{DD}	0	7.0	V		
Operating Temperature	Normal	Top	0	+50	°C	Note 1
	Wide		-20	+70		
Storage Temperature	Normal	T _{st}	-20	+70	°C	Note 2
	Wide		-30	+80		
Static Electricity	Be sure that you are grounded when handling displays.					

Note 1: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible. Ta ≤ 70 °C: 75% RH max

Note 2: Ta ≤ 80 °C: 75% RH max

3.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply for Logic	V _{DD} -V _{SS}	Ta = 25°C	4.75	--	5.25	V
Input Voltage	V _{IHC}	Ta = 25°C	0.7 V _{DD}	--	V _{DD}	V
	V _{ILC}	Ta = 25°C	0	--	0.6	V
LCD Module Driving Voltage	V _{DD} -V _O	Ta = 25°C	0	--	10.0	V
Current Consumption	* I _{DD}	V _{DD} -V _{SS} = 5V	--	2.4	--	mA

* I_{DD} measurement condition is for all pattern ON

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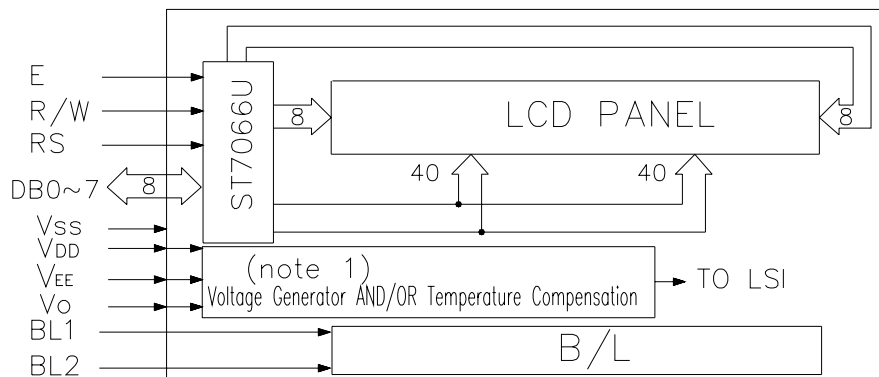
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3.3 INTERFACE PIN ASSIGNMENT

3.3.1 I/O pin function (EL)

Pin No.	Function	Level	Description
1	Vss	–	Ground (0V)
2	Vdd	–	Logic Supply Voltage (+5V)
3	Vo	–	Voltage Level for LCD Control Adjustment
4	RS	I	Register Select 0: Instruction Register 1: Data Register
5	R/W	I	Read / Write 0: Data Write (Module ← MPU) 1: Data Read (Module → MPU)
6	E	I	Enable Signal Active High (H → L)
7 ~ 14	DB0 ~ 7	I/O	Bi-directional data bus line 0 ~ 7
15	NC(Vee)		No connection(Alternative Power Supply)
16	N/A		---
BL1	EL		EL B/L
BL2	EL		EL B/L

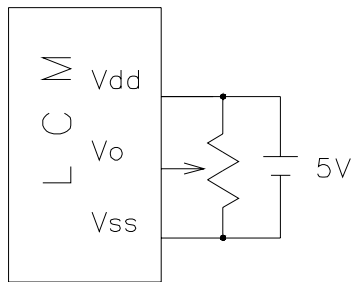
3.4 BLOCK DIAGRAM



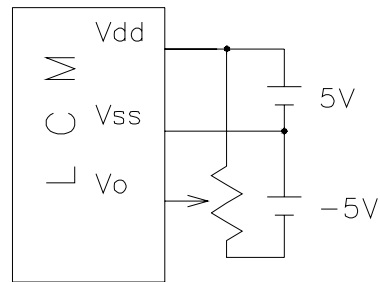
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3.5 POWER SUPPLY CIRCUIT



Normal temp.



Wide temp.

RECOMMENDED Vr: 10K ohm ~ 20K ohm

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3.6 CHARACTER FONT

NO.7066-0A

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
CG RAM (1)				0	1	A	Q	a	q			-	9	3	e	p
0001 (2)		!	1	A	Q	a	q			.	7	4	a	q		
0010 (3)		"	2	B	R	b	r			「	イ	ツ	×	β	θ	
0011 (4)		#	3	C	S	c	s			」	ウ	テ	ε	ε	∞	
0100 (5)		\$	4	D	T	d	t			、	イ	ト	ト	μ	Ω	
0101 (6)		%	5	E	U	e	u			・	オ	ナ	1	ε	Ω	
0110 (7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ	
0111 (8)		'	7	G	W	g	w			フ	キ	ヌ	ウ	g	π	
1000 (1)		(8	H	X	h	x			イ	ウ	ホ	リ	フ	ア	
1001 (2))	9	I	Y	i	y			ウ	ケ	ル	リ	ウ		
1010 (3)		*	:	J	Z	j	z			エ	コ	ル	ル	j	キ	
1011 (4)		+	:	K	L	k	l			オ	サ	ヒ	ロ	°	ク	
1100 (5)		,	<	L	¥	l	l			ホ	シ	フ	フ	¢	ク	
1101 (6)		-	=	M	I	m	i			ユ	ヌ	ハ	ン	ト	÷	
1110 (7)		.	>	N	^	n	→			ヨ	セ	ホ	°	ン		
1111 (8)		/	?	O	_	o	←			ウ	リ	マ	°	ö		

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3.7 AC TIMING CHARACTERISTICS

ST7066U

■ AC Characteristics

(TA = 25°C, VCC = 5V)

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
f _{OSC}	OSC Frequency	R = 91KΩ	190	270	350	KHz
<i>External Clock Operation</i>						
f _{EX}	External Frequency	-	125	270	410	KHz
	Duty Cycle	-	45	50	55	%
T _R , T _F	Rise/Fall Time	-	-	-	0.2	μs
<i>Write Mode (Writing data from MPU to ST7066U)</i>						
T _C	Enable Cycle Time	Pin E	1200	-	-	ns
T _{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T _R , T _F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T _{AS}	Address Setup Time	Pins: RS, RW, E	0	-	-	ns
T _{AH}	Address Hold Time	Pins: RS, RW, E	10	-	-	ns
T _{DSW}	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
T _H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
<i>Read Mode (Reading Data from ST7066U to MPU)</i>						
T _C	Enable Cycle Time	Pin E	1200	-	-	ns
T _{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T _R , T _F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T _{AS}	Address Setup Time	Pins: RS, RW, E	0	-	-	ns
T _{AH}	Address Hold Time	Pins: RS, RW, E	10	-	-	ns
T _{DDR}	Data Setup Time	Pins: DB0 - DB7	-	-	100	ns
T _H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
<i>Interface Mode with LCD Driver(ST7065)</i>						
T _{CWH}	Clock Pulse with High	Pins: CL1, CL2	800	-	-	ns
T _{CWL}	Clock Pulse with Low	Pins: CL1, CL2	800	-	-	ns
T _{CST}	Clock Setup Time	Pins: CL1, CL2	500	-	-	ns
T _{SJ}	Data Setup Time	Pin: D	300	-	-	ns
T _{DH}	Data Hold Time	Pin: D	300	-	-	ns
T _{DM}	M Delay Time	Pin: M	0	-	2000	ns

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4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

Ta = 25 °C

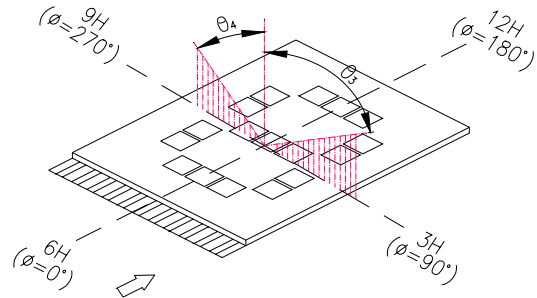
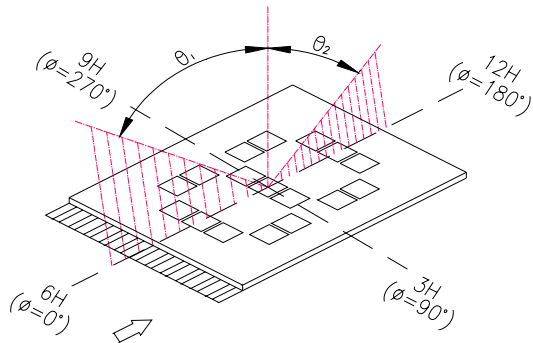
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2	--	35	--	deg	1
	θ2	CR≥2	--	20	--	deg	1
	θ3	CR≥2	--	30	--	deg	2
	θ4	CR≥2	--	30	--	deg	2
Contrast Ratio	CR	Ta = 25 °C	2	5	--	-	3
Response Time	Tr	Ta = 25 °C	--	150	220	ms	4
	Tf	Ta = 25 °C	--	180	270		
Driving Method	Duty	1/16					
	Bias	1/5					
LCD Type	STN						
Mode	Reflective - Transflective - Positive						

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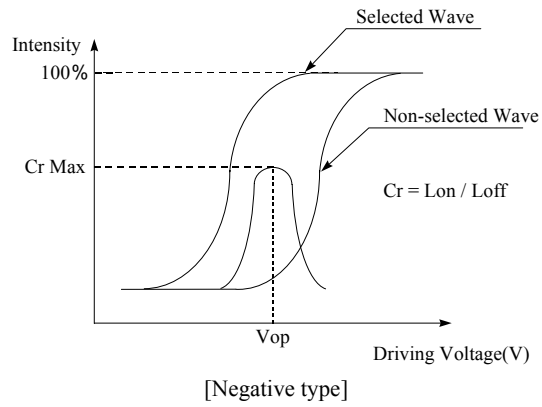
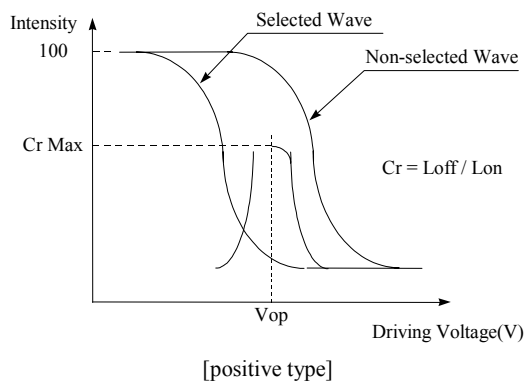
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Note 1: definition of viewing angle θ_1 & θ_2

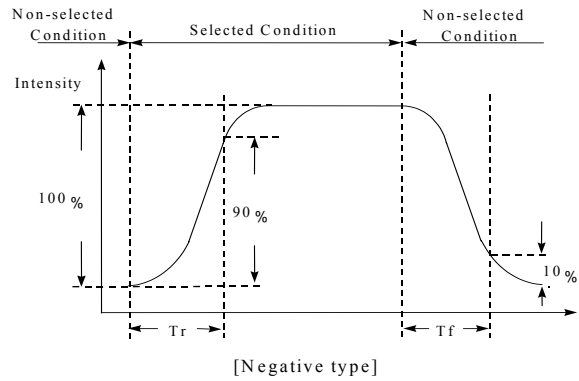
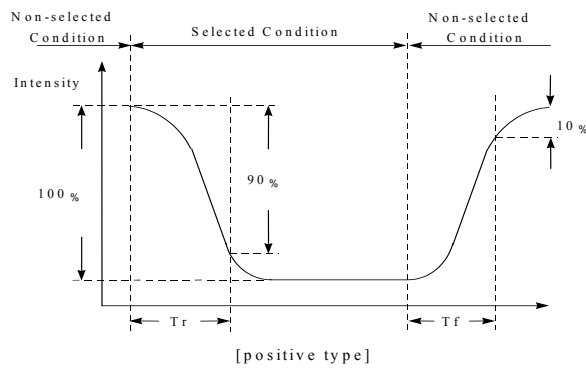
Note 2: definition of viewing angle θ_3 & θ_4



Note 3: definition of contrast ratio (CR)



Note 4: definition of response time



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5 BACKLIGHT CHARACTERISTICS

5.1 EL B/L operating range

Item	Conditions	Standard			Unit
		Min.	Typ.	Max.	
Input voltage	Ta = 25 C (400 ~ 800 Hz)	---	100	---	Vrms
Current consumption	Ta = 25 C		2.7		mA
Average brightness (B/L only) (Ta = 25C, I = 2.7mA)	Test when connecting after 3 min. Ta=25C (max. contrast)	---	50	---	cd/m2 (Note 2)
Lamp life	Ta = 25 C , I = 2.7 mA Humidity : 30%RH ~ 85%RH	---	3,000	---	Hrs (Note 4)
Operating Temp.	Humidity : 30%RH ~ 85%RH	-20	---	70	C
Storage Temp.	Humidity : 30%RH ~ 85%RH	-30	---	80	C

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6 QUALITY ASSURANCE SPECIFICATION

6.1 CONFORMITY

The performance, function and reliability of the shipped products conform to the Product Specification.

6.2 DELIVERY ASSURANCE

6.2.1 Delivery inspection standards

- MIL-STD-105E, general inspection level II, single sampling level;
- IPC-AA610 rev. C, class 2 electronic assemblies standard

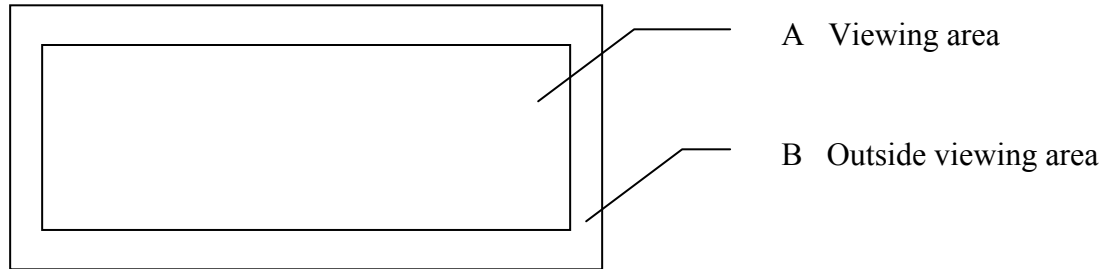
The quality assurance levels are shown below:

Class	AQL (%)
Critical defect	0.5%
Major defect	1.0%
Minor defect	1.5%
TOTAL	2.0%

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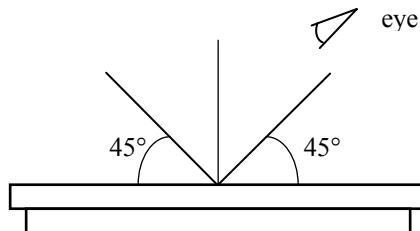
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6.2.2 Zone definition



6.2.3 Visual inspection

- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.

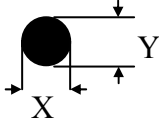
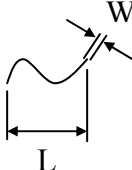
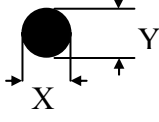


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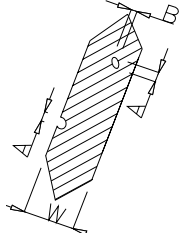
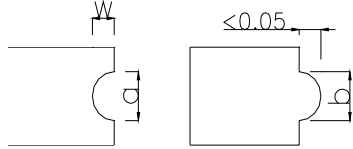
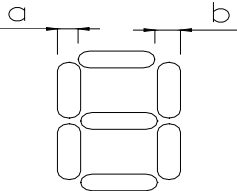
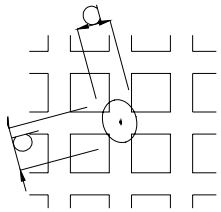
6.2.3.1 Standard of appearance inspection

Units: mm

Class	Item	Criteria																																				
Minor	Packing & Label	Outside & inside package																																				
Critical		Presence of product no., lot no., quantity																																				
		Product must not be mixed with others and quantity must not be different from that indicated on the label																																				
Major	Dimension	Product dimensions must be according to specification and drawing																																				
Major	Electrical	Product electrical characteristics must be according to specification																																				
Critical	LCD Display	Missing lines or wrong patterns on LCD display are not allowed																																				
Minor	Black spot, white spot, dust	<p>Round type: as per following drawing $\varnothing = (X+Y)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\varnothing < 0.1$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.1 < \varnothing < 0.2$</td> <td>2</td> </tr> <tr> <td>$0.2 < \varnothing < 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \varnothing$</td> <td>0</td> </tr> </tbody> </table> <p>Line type: as per following drawing</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="4">Acceptable quantity</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>--</td> <td>$W \leq 0.02$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.02 < W \leq 0.03$</td> <td>2</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> <td></td> </tr> <tr> <td>--</td> <td>$0.05 < W$</td> <td>As round type</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.1$	Any number	Any number	$0.1 < \varnothing < 0.2$	2	$0.2 < \varnothing < 0.25$	1	$0.25 < \varnothing$	0	Acceptable quantity				Length	Width	Zone A	Zone B	--	$W \leq 0.02$	Any number	Any number	$L \leq 3.0$	$0.02 < W \leq 0.03$	2	$L \leq 2.5$	$0.03 < W \leq 0.05$		--	$0.05 < W$	As round type
Acceptable quantity																																						
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$0.1 < \varnothing < 0.2$	2																																					
$0.2 < \varnothing < 0.25$	1																																					
$0.25 < \varnothing$	0																																					
Acceptable quantity																																						
Length	Width	Zone A	Zone B																																			
--	$W \leq 0.02$	Any number	Any number																																			
$L \leq 3.0$	$0.02 < W \leq 0.03$	2																																				
$L \leq 2.5$	$0.03 < W \leq 0.05$																																					
--	$0.05 < W$	As round type																																				
Minor	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																				
Minor	Polariser bubble	<p>$\varnothing = (X+Y)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>$\varnothing < 0.2$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.2 < \varnothing < 0.5$</td> <td>2</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</td> <td>1</td> </tr> <tr> <td>$1.0 < \varnothing$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.2$	Any number	Any number	$0.2 < \varnothing < 0.5$	2	$0.5 < \varnothing < 1.0$	1	$1.0 < \varnothing$	0																					
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$1.0 < \varnothing$	0																																					

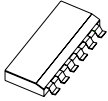
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Class	Item	Criteria																												
Minor	Segment deformation	<p>1.a. Pin hole on segmented display W: segment width $\varnothing = (A+B)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th>\varnothing</th> </tr> </thead> <tbody> <tr> <td>$W \leq 0.4$</td> <td>$\varnothing \leq 0.2$ and $\varnothing \leq 1/2W$</td> </tr> <tr> <td>$W > 0.4$</td> <td>$\varnothing \leq 0.25$ and $\varnothing \leq 1/3W$</td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment Pin holes with \varnothing under 0.10 mm are acceptable</p>	Acceptable quantity		Width	\varnothing	$W \leq 0.4$	$\varnothing \leq 0.2$ and $\varnothing \leq 1/2W$	$W > 0.4$	$\varnothing \leq 0.25$ and $\varnothing \leq 1/3W$																				
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Minor	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 \leq 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>2. Segments / dots with different width</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> </thead> <tbody> <tr> <td>$a \geq b$</td> <td>$a/b \leq 4/3$</td> </tr> <tr> <td>$a < b$</td> <td>$a/b > 4/3$</td> </tr> </tbody> </table> <p>3. Alignment layer defect $\varnothing = (a+b)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$\varnothing \leq 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \varnothing \leq 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \varnothing \leq 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \varnothing \leq 2.0$</td> <td>2</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p>	Acceptable quantity		Size		$a, b < 0.1$	Any number	$(a+b)/2 \leq 0.1$	Any number	$0.5 < \varnothing < 1.0$	3	Acceptable		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	Acceptable quantity		Size		$\varnothing \leq 0.4$	Any number	$0.4 < \varnothing \leq 1.0$	5	$1.0 < \varnothing \leq 1.5$	3	$1.5 < \varnothing \leq 2.0$	2
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Minor	Colour uniformity	Level of sample for approval set as limit sample																												
Critical	Backlight	The backlight colour should correspond to the product specification																												
Critical		Flashing and or unlit backlight is not allowed																												
Minor		Dust larger than 0.25 mm is not allowed																												
Major	COB	Exposed wire bond pad is not allowed																												
Major		Insufficient covering with resin is not allowed (wire bond line exposed)																												
Minor		Dust or bubble on the resin are not allowed																												

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Class	Item	Criteria													
Major		No unmelted solder paste should be present on PCB													
Critical		Cold solder joints, missing solder connections, or oxidation are not allowed													
Minor		No residue or solder balls on PCB are allowed													
Critical		Short circuits on components are not allowed													
Minor	Tray particles	<table border="1"> <thead> <tr> <th></th> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">On tray</td> <td>$\varnothing < 0.2$</td> <td>Any number</td> </tr> <tr> <td>$\varnothing > 0.25$</td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td>$\varnothing \geq 0.25$</td> <td>2</td> </tr> <tr> <td>$L = 3$</td> <td>1</td> </tr> </tbody> </table>		Size	Quantity	On tray	$\varnothing < 0.2$	Any number	$\varnothing > 0.25$	4	On display	$\varnothing \geq 0.25$	2	$L = 3$	1
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6.3 DEALING WITH CUSTOMER COMPLAINTS

6.3.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample.

After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform the purchaser.

6.3.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

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7 RELIABILITY TEST

7.1 Reliability (Normal temp. LCM)

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	50°C ±2°C, 240 hours	No abnormalities in function* and appearance
Low Temperature Operation	0°C ±2°C, 240 hours	No abnormalities in function* and appearance
Thermal Shock Storage (Non operation)	-20°C (30 min)->25°C (5 min)->70°C (30 min)->25°C (5 min) 5 cycles.	No abnormalities in function* and appearance
Vibration (Non operation)	10 Hz~55 Hz 0.3mm / 1 Octave 55 Hz~500 Hz 3g / 1 Octave 20 cycles per axis	No abnormalities in function* and appearance

7.2 Reliability (Wide temp. LCM)

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70°C ±2°C, 240 hours	No abnormalities in function* and appearance
Low Temperature Operation	-20°C ±2°C, 240 hours	No abnormalities in function* and appearance
Thermal Shock Storage (Non operation)	-30°C (30 min)->25°C (5 min)->80°C (30 min)->25°C (5 min) 5 cycles.	No abnormalities in function* and appearance
Vibration (Non operation)	10 Hz~55 Hz 0.3mm / 1 Octave 55 Hz~500 Hz 3g / 1 Octave 20 cycles per axis	No abnormalities in function* and appearance

7.3 LIFE TIME

Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions of room temperature (25±10 °C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.

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8 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

LR2128①②1C16③④⑤

- ① **Polarizer Type**
 A= Reflective: light background with no backlight.
 B = Transflective: light background with blue-green EL backlight.
- ② **Not applicable - LEAVE BLANK**
- ③ **Fluid Type and Power Supply**
 S = STN with +5VDC operation
 H = Wide temperature range, negative supply voltage required.
- ④ **Fluid Type Viewing Direction**
 N = STN
- ⑤ **Background Color for STN Temperature Range**
 G = Gray background
 Y = Yellow background

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9 HANDLING PRECAUTIONS

Safety

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes.
If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

Mounting and Design

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface. When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

Caution during LCD cleaning

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polariser surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

Caution against static charge

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on.
Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

Packaging

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height. To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

Caution during operation

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

Storage

Store the display in a dark place where the temperature is $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases. Do not crash, shake or jolt the display (including accessories).

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