

LIQUID CRYSTAL DISPLAY MODULE

Standard Product Specification

PRODUCT NUMBER	TSR42315 / TSR62315
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Product Mgr	Engineering	Document Control
Elijah Ebo	Bazile Peter	Anthony Perkins
Date 2 nd Nov 2007	Date 2 nd Nov 2007	Date 2 nd Nov 2007

Product No.	TSR42315	REV. A
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REVISION RECORD

Rev.	Date	Page	Chap.	Comment	ECN no.
A	02/11/07	--	--	Initial Release, ROHS	

1 MAIN FEATURES

ITEM	CONTENTS	REMARK
Display Format	240 dots x 128 dots	
Colour	Monochrome	
Overall Dimensions	144.0 (W) x 104.0 (H) x 17.4 Max. (D) without negative voltage and temperature compensation 144.0 (W) x 104.0 (H) x 20.2 Max. (D) with negative voltage and temperature compensation	
Viewing Area	114.0 (W) x 64.0 (H)	
LCD Type	Reference Section 8 – Part Number Description.	See page 28
Mode		
Viewing Angle	6 o'clock	
Duty Ratio	1/128	
Driver IC/Controller	Toshiba T6963	
Backlight Type	Reference Section 8 – Part Number Description.	See page 28
Backlight Colour		
DC/DC Converter	Optional	
Operating Temperature	-20°C ~ +70°C	Note 1
Storage Temperature	-30°C ~ +80°C	Note 2
ROHS Compliant	Yes	

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.

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	240 (W) x 128 (H)	Dots
Overall Dimensions	144.0 (W) x 104.0 (H) x 17.4 Max. (D) without negative voltage and temperature compensation 144.0 (W) x 104.0 (H) x 20.2 Max. (D) with negative voltage and temperature compensation	mm
Viewing Area	114.0 (W) x 64.0 (H)	mm
Active Area	107.95 (W) x 57.55 (H)	mm
Dot Size	0.40 (W) x 0.40 (H)	mm
Dot Spacing	0.45 (W) x 0.45 (H)	mm
IC Controller/Driver	Toshiba T6963	

2.2 LABELLING & MARKING

Reference Section 8 – Part Number Description: Page 18

DENSITRON TSR4/62315 TAIWAN YYMM
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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	V	50± 10% RH
Operating temperature	Topr	0	50	°C	<65% (Normal Temp)
		-20	70	°C	<65% (Wide Temp)
Storage temperature	Tstg	-20	70	°C	<65% (Normal Temp)
		-30	80	°C	<65% (Wide Temp)
		20	90	%RH	<48 hrs
		20	65	%RH	<1000 hrs
Static Electricity	Be sure that you are grounded when handling displays.				

3.2 ELECTRICAL CHARACTERISTICS

3.2.1 Input Voltage

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Spec			Unit	
			Min	Typ	Max		
Input voltage	High	Vi _{hc}	V _{dd} =5.0 ±5%	4.75	5.0	5.25	V
	Low	Vi _{lc}		0	-	1.0	

3.2.2 LCM Current consumption & driving voltage

		FSTN Temperature		STN Temperature	
		Normal	Wide	Normal	Wide
Supply current (I _{dd}) Max, mA		12	12	12	12
Supply current (I _{ee}) Typ, mA		5	5	5	5
Recommended LCD drive voltage					
LCD driving voltage	T _a = -20°C	N/A	16.8	N/A	16.0
	T _a = 0°C	16.3	16.3	15.8	15.8
	T _a = 25°C	16.1	16.1	15.6	15.6
	T _a = 50°C	15.7	15.7	15.2	15.2
	T _a = 70°C	N/A	15.1	N/A	14.8

Note: The Current consumption (I_{dd}) is 65mA (Max) when built in NV (negative voltage) or NVTC (negative voltage and temperature compensation)

3.3 INTERFACE PIN ASSIGNMENT

3.3.1 Array LED version

Pin	Function	Level	Description
1	Vss	-	Power supply (0V, GND)
2	Vdd	-	Power supply for logic
3	Vo	-	Voltage level for LCD control adjustment
4	C/D	H/L	Write mode H: Command write. L: Data write Read mode H: Status read L: Data read
5	/RD	L	Data AND Read signal
6	/WR	L	Command and Data Write
7~14	DB0~7		Display Data 0~7
15	/CE	L	Chip enable signal
16	/RESET	L	Reset signal
17	VEE	-	Power supply for LCD drive
18	MD2	-	Terminals for selection for columns
19	FS1	-	Terminals for selection of font. Note 1
20	NC	-	No connection
BL1	LED+	H	Anode (+): of LED Backlight
BL2	LED-	L	Cathode (-): LED Backlight
BL3	N/C	-	No Connection
BL4	N/C	-	No Connection
BL5	N/C	-	No Connection

Pin outs for following Variants:

TSR42315BG128G240HNG
 TSR42315BG128G240HNY
 TSR42315BG128G240WNG
 TSR42315EG128G240HNB
 TSR42315EG128G240WNB
 TSR42315EG128G240WCB
 TSR42315BG128G240WNY
 TSR42315BG128G240WCG
 TSR42315BG128G240WCY

3.3.2 Edge LED version

Pin	Function	Level	Description
1	Vss/LED(-)	-	Power supply (0V, GND) / Cathode of LED B/L
2	Vdd	-	Power supply for logic
3	Vo	-	Voltage level for LCD control adjustment
4	C/D	H/L	Write mode H: Command write. L: Data write Read mode H: Status read L: Data read
5	/RD	L	Data AND Status Read signal
6	/WR	L	Command and Data Write signal
7~14	DB0~7		Display Data 0~7
15	/CE	L	Chip enable signal
16	/RESET	L	Reset signal
17	VEE	-	Power supply for LCD drive
18	MD2	-	Terminals for selection for columns
19	FS1	-	Terminals for selection of font. Note 1
20	LED(+)	H	Anode of LED B/L
BL1	N/C	-	No Connection
BL2	N/C	-	No Connection
BL3	N/C	-	No Connection
BL4	LED(+)	H	Anode of LED B/L
BL5	LED(-)	L	Cathode of LED B/L

Pin outs for following Variants:

TSR42315EW128G240HNB

TSR42315EW128G240WNB

TSR42315EW128G240WCB

TSR42315EW128G240HF

TSR42315EW128G240WF

TSR42315EW128G240WCF

TSR42315BW128G240HF

TSR42315BW128G240WF

TSR42315BW128G240WCF

3.3.3 CCFT version

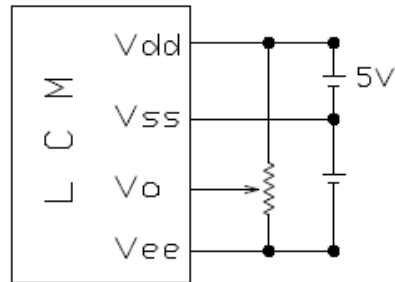
Pin	Function	Level	Description
1	V _{SS}	-	Power supply (0V, GND)
2	V _{DD}	-	Power supply for logic
3	V _O	-	Voltage level for LCD control adjustment
4	C/D	H/L	Write mode H: Command write. L: Data write Read mode H: Status read L: Data read
5	/RD	L	Data AND Status Read signal
6	/WR	L	Command and Data Write signal
7~14	DB0~7		Display Data 0~7
15	/CE	L	Chip enable signal
16	/RESET	L	Reset signal
17	V _{EE}	-	Power supply for LCD drive
18	MD2	-	Terminals for selection for columns
19	FS1	-	Terminals for selection of font. Note 1
20	N/C	-	No Connection
BL1	CCFT	-	CCFT
BL2	CCFT	-	CCFT
BL3	N/C	-	No Connection
BL4	N/C	-	No Connection
BL5	N/C	-	No Connection

Pin outs for following Variants:

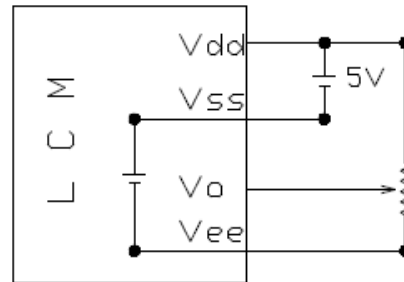
Note 1:

MD2	H	L	FS1	H	L
Columns	32	40	Font	6x8	8x8

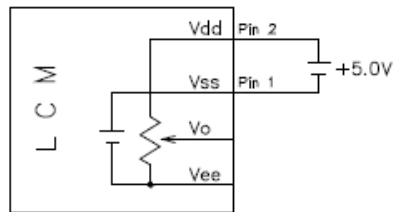
3.4 POWER SUPPLY CIRCUIT



NEGATIVE VOLTAGE
NOT BUILT IN



NEGATIVE VOLTAGE
BUILT IN

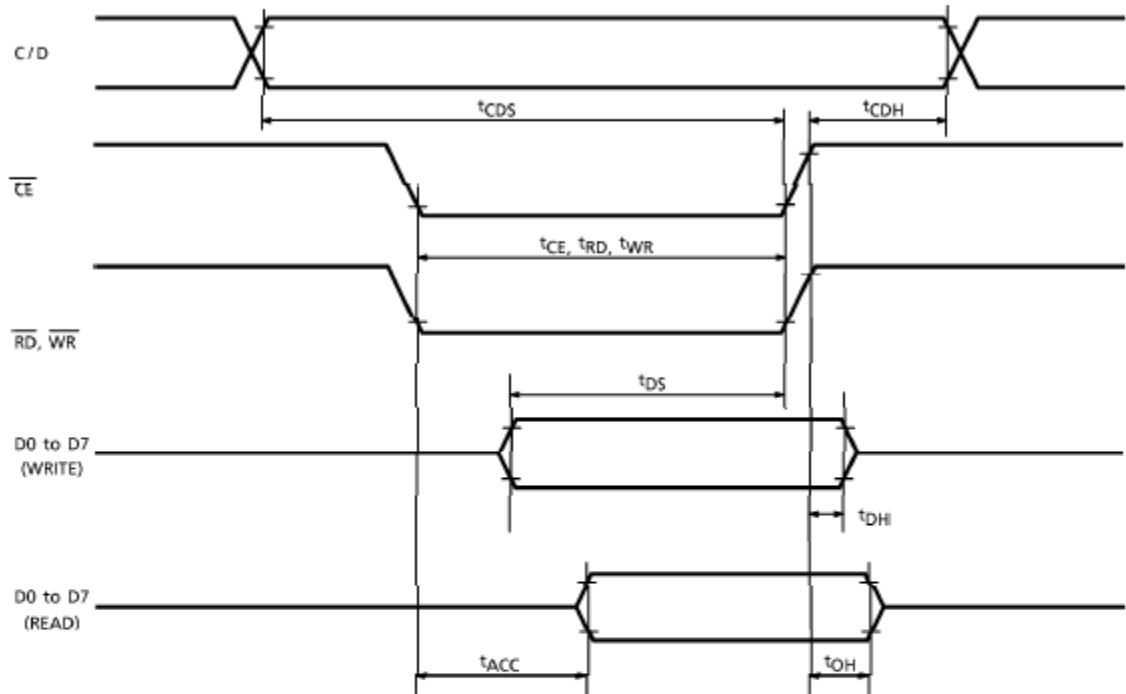


Negative Voltage and Temperature
Compensation built in

RECOMMENDED V_R : 10K ohm ~ 20K ohm

3.5 TIMING CHARACTERISTICS

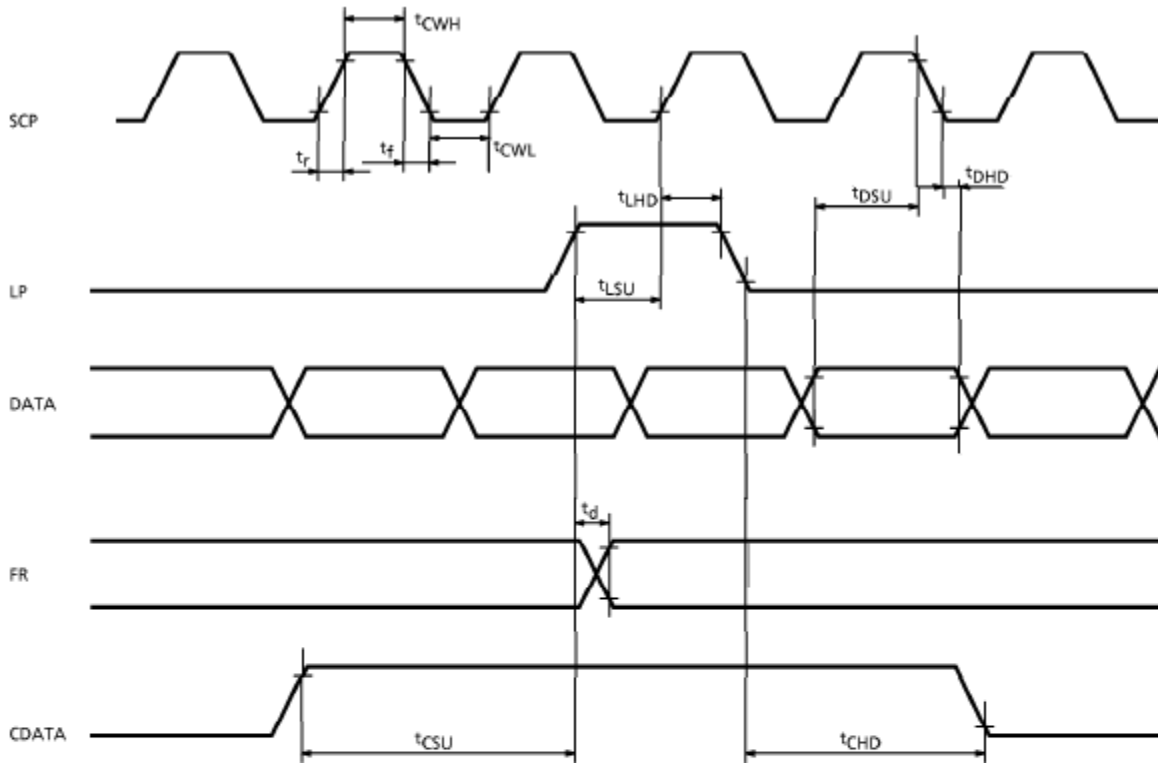
Bus Timing



TEST CONDITIONS (Unless otherwise noted, $V_{DD} = 5.0V \pm 10\%$, $V_{SS} = 0V$, $T_a = -20$ to $75^\circ C$)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
C/D Set-up Time	t_{CDS}	—	100	—	ns
C/D Hold Time	t_{CDH}	—	10	—	ns
CE, RD, WR Pulse Width	t_{CE}, t_{RD}, t_{WR}	—	80	—	ns
Data Set-up Time	t_{DS}	—	80	—	ns
Data Hold Time	t_{DH}	—	40	—	ns
Access Time	t_{ACC}	—	—	150	ns
Output Hold Time	t_{OH}	—	10	50	ns

3.6 AC CHARACTERISTICS



TEST CONDITIONS (Unless otherwise noted, $V_{DD} = 5.0V \pm 10\%$, $V_{SS} = 0V$, $T_a = -20$ to $70^\circ C$)

ITEM	SYMBOL	TEST CONDITIONS	MIN	MAX	UNIT
Operating Frequency	f_{scp}	$T_a = -10 \sim 70^\circ C$	—	2.75	MHz
SCP Pulse Width	t_{CWH}, t_{CWL}	—	150	—	ns
SCP Rise / Fall Time	t_r, t_f	—	—	30	ns
LP Set-up Time	t_{LSU}	—	150	290	ns
LP Hold Time	t_{LHD}	—	5	40	ns
Data Set-up Time	t_{DSU}	—	170	—	ns
Data Hold Time	t_{DHD}	—	80	—	ns
FR Delay Time	t_d	—	0	90	ns
CDATA Set-up Time	t_{CSU}	—	450	850	ns
CDATA Hold Time	t_{CHD}	—	450	950	ns

4 CHARACTER FONT

CHARACTER CODE MAP
ROM code 0101

LSB MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
0		!	"	#	\$	%	&	'	()	*	+	,	-	.	/	
1		0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
2		@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3		P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
4		`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
5		p	q	r	s	t	u	v	w	x	y	z	{		}	~	
6		5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
7		é	æ	ø	ö	ó	ü	9	0	0	0	0	0	0	0	0	0

CG ROM TYPE 0201

LSB MSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
0		!	"	#	\$	%	&	'	()	*	+	,	-	.	/	
1		0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
2		@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
3		P	Q	R	S	T	U	V	W	X	Y	Z	[\]	^	_
4		千	万	十	百	千	万	十	百	千	万	十	百	千	万	十	百
5		一	二	三	四	五	六	七	八	九	十	百	千	万	十	百	
6		夕	子	ツ	テ	ト	ナ	ニ	ヌ	ネ	ノ	ハ	ヘ	フ	ハ	ホ	
7		エ	ク	ケ	コ	ク	ケ	コ	ク	ケ	コ	ク	ケ	コ	ク	ケ	コ

5 OPTICAL SPECIFICATION

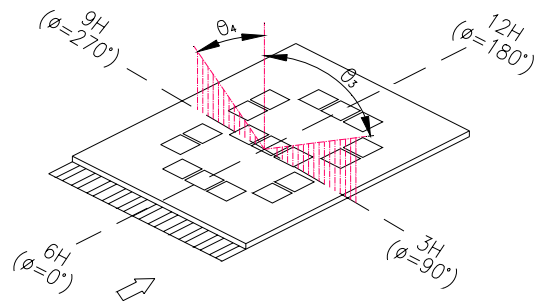
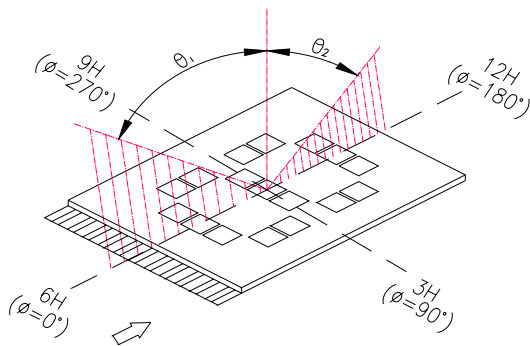
5.1 OPTICAL CHARACTERISTICS

Ta = 25 °C

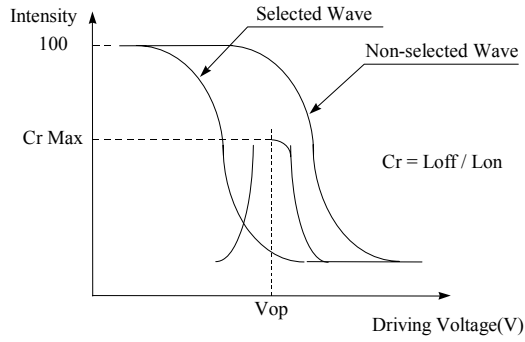
Item	Symbol	Condition	Min	Typ	Max	Unit	Note	
Viewing Angle	θ_1	CR \geq 2	-	30	-	deg	1	
	θ_2	CR \geq 2	-	20	-	deg	1	
	θ_3	CR \geq 2	-	30	-	deg	2	
	θ_4	CR \geq 2	-	30	-	deg	2	
Contrast Ratio	CR	Ta = 25°C	3	5	--	-	3	
Response Time	Tr	Ta = 25°C	--	300	--	ms	4	
	Tf	Ta = 25°C	--	300	--			
Driving Method	Duty	1/128						
	Bias	1/9						
Viewing Direction	6 o'clock							

Note 1: definition of viewing angle θ_1 & θ_2

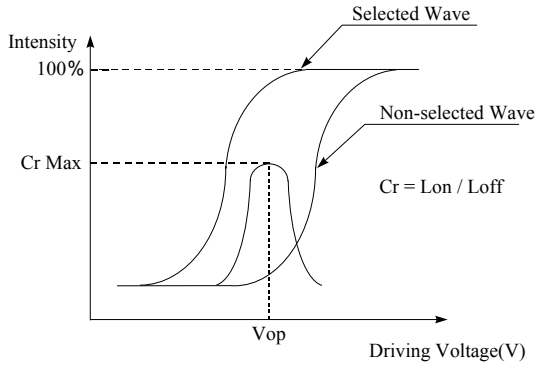
Note 2: definition of viewing angle θ_3 & θ_4



Note 3: definition of contrast ratio (CR)

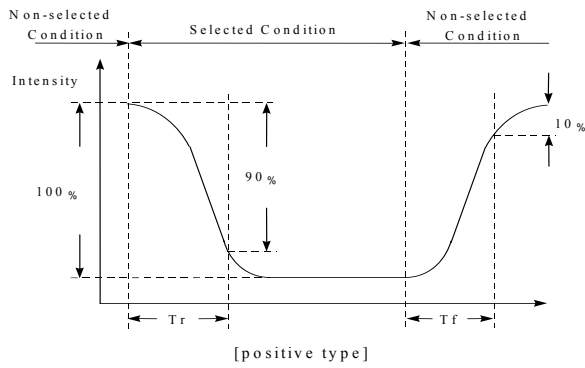


[positive type]

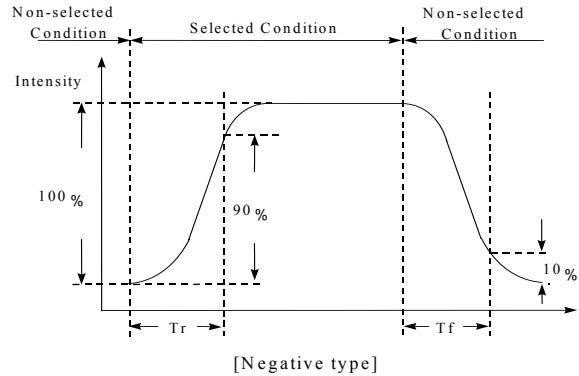


[Negative type]

Note 4: definition of response time



[positive type]



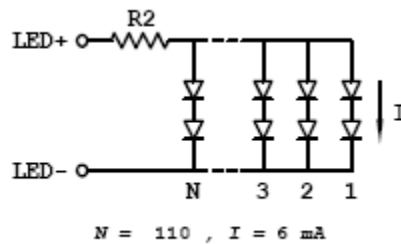
[Negative type]

6 BACKLIGHT SPECIFICATION

6.1.1 Led Array

Item	Conditions	Standard			Unit
		Min	Typ	Max	
Input Voltage	Ta = 25°C	-	5.0	-	V(DC)
Current consumption	Ta = 25°C	-	660	-	mA
Average brightness B/L only (Ta = 25°C, IL = 660mA)	Test when connecting after 3 min. Ta = 25°C (max contrast)				
	Array yellow-green edge B/L	100	-	-	cd/m ² (note 2)
Brightness uniformity	Ta = 25°C, IL = 660mA	80	-	-	% (note 3)
Lamp Life	Ta = 25°C, IL = 660mA Humidity: 30% RH~85% RH	-	50000	-	Hrs (note 4)
Operating Temp	Humidity: 30% RH~85% RH	-20	-	70	°C
Storage Temp	Humidity: 30% RH~85% RH	-30	-	80	°C
Limit resistor	Ta = 25°C	-	1.7	-	Ohm (note 1)

Note 1: The suggested limit resistor of array LED B/L is 1.7 ohm, 2W.



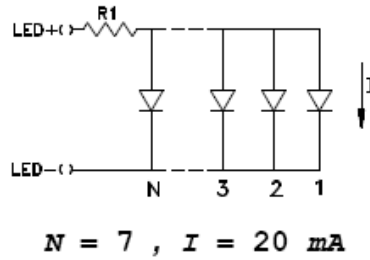
6.1.2 CCFT B/L operating range

Item	Conditions	Standard			Unit
		Min	Typ	Max	
Starting Voltage	Ta = 0°C	-	360	500	Vrms
Lamp Voltage	Ta = 25°C	225	250	275	Vrms
Lamp Current	Ta = 25°C	4.5	5.0	5.5	mA
Oscillation frequency	Ta = 25°C	-	42.0	75.0	KHz
Average brightness B/L only (Ta = 25°C, IL = 5mA)	Test when connecting after 3 min. Ta = 25°C (max contrast)				
	White B/L	900	-	-	cd/m ² (note 2)
Lamp Life	Ta = 25°C, IL = 5mA Humidity: 30% RH~85% RH	-	27000	-	Hrs (note 4)
Operating Temp	Humidity: 30% RH~85% RH	0	-	60	°C
Storage Temp	Humidity: 30% RH~85% RH	-30	-	80	°C
Brightness uniformity	Ta = 25°C	75	-	-	% (note 3)

6.1.3 Edge LED B/L operating range

Item	Conditions	Standard			Unit
		Min	Typ	Max	
Input Voltage	Ta = 25°C	-	5.0	-	V(DC)
Current consumption	Ta = 25°C	-	140	-	mA
Average brightness B/L only (Ta = 25°C, IL = 140mA)	Test when connecting after 3 min. Ta = 25°C (max contrast)				
	White B/L	-	180	-	cd/m ² (note 2)
Brightness uniformity	Ta = 25°C, IL = 660mA	80	-	-	% (note 3)
Lamp Life	Ta = 25°C, IL = 660mA Humidity: 30% RH~85% RH	-	40000	-	Hrs (note 4)
Operating Temp	Humidity: 30% RH~85% RH	-20	-	70	°C
Storage Temp	Humidity: 30% RH~85% RH	-30	-	80	°C

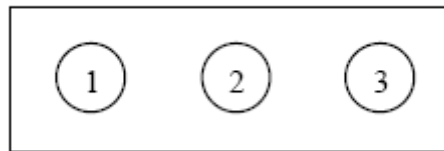
Note: The limit resistor of LED B/L is built in LED board.



Note 2: Average brightness of 3 points when B/L is used at the beginning.

Note 3: Brightness uniformity = (Min/Max) x 100%

Note 4: Half the original average brightness.



7 TOUCH PANEL SPECIFICATION

7.1 Characteristics

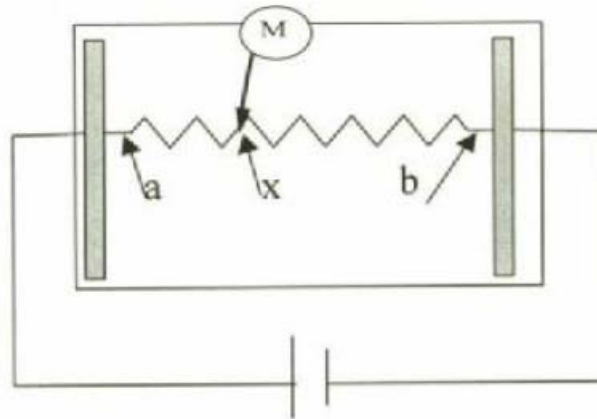
Description	Specification	Condition
Transparency	$\geq 70\%$	ASTM D1003 (wavelength = 550nm)
Linearity	$\leq 2.0\%$	Material of pen: Poly-acetal resin End shape: R0.8mm Test Point: 100 points Test Force: 80gf Note 1
Circuit Resistance (X-axis)	200 ohm ~ 550 ohm	At connector
Circuit Resistance (Y-axis)	200 ohm ~ 550 ohm	At connector
Chattering time	$\leq 30\text{ms}$	Voltage: 3V Frequency: 5Hz
Activation force	60 gf ~ 80 gf	End shape: R0.8mm Resistance must be equal or lower than 2k ohm between X and Y axis when testing voltage is 5V

7.1.1 Durability Tests

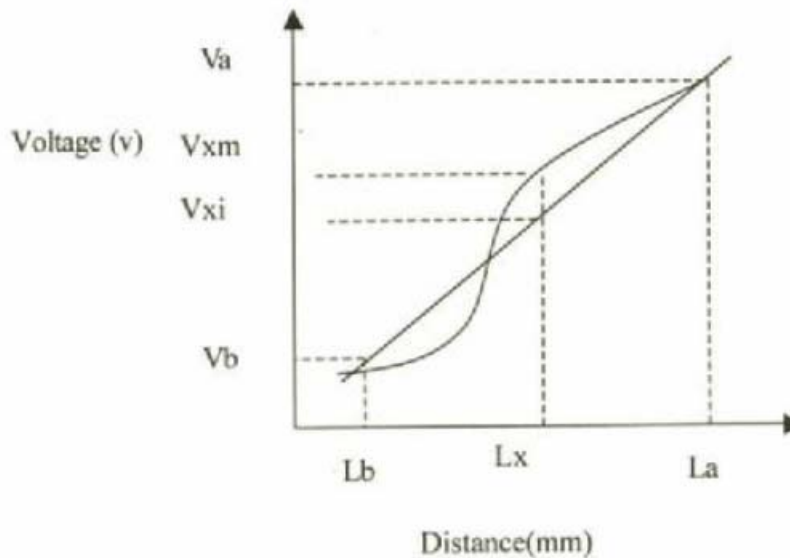
Description	Specification	Condition
Pen sliding durability	$\geq 100,000$ times	End shape: R0.8mm Load force: 250gf Writing speed: 300 mm/sec Material of pen: Poly-acetal resin Sliding length: 35mm
Knocking test	$\geq 1,000,000$ times	End shape: R0.8mm (hardness :50~60 degree) Load force: 250gf Frequency: 5 Hz (By silicon rubber tapping at same points)
Hardness of surface	2H	JIS K 5400

Note 1: Measurement condition of Linearity

Linearity Definition



- Va : maximum voltage in the active area of touch panel
- Vb: minimum voltage in the active area of touch panel
- X : random measuring point
- Vxm: Actual voltage of Lx point
- Vxi : Theoretical voltage of Lx point



$$\text{Linearity} : [| V_{xi} - V_{xm} | / (V_a - V_b)] * 100\%$$

8 QUALITY ASSURANCE SPECIFICATION

8.1 CONFORMITY

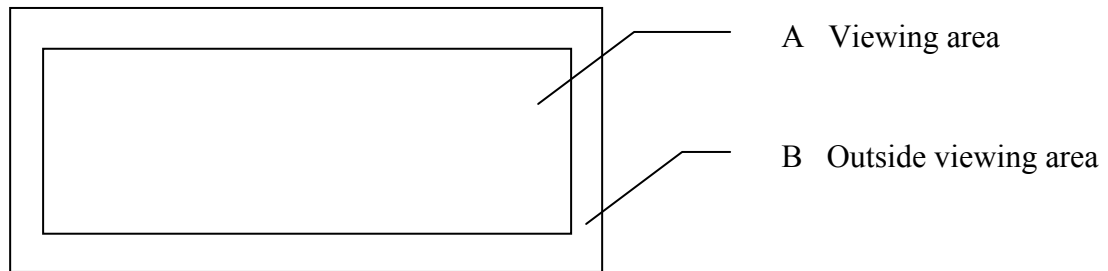
The performance, function and reliability of the shipped products conform to the Product Specification.

8.2 DELIVERY ASSURANCE

8.2.1 Delivery inspection standards

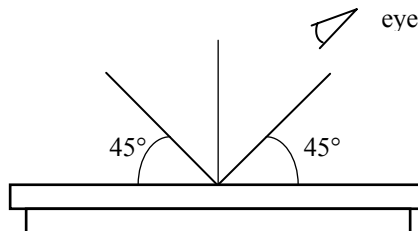
- IPC-AA610, class 2 electronic assemblies standard

8.2.2 Zone definition



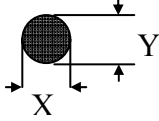
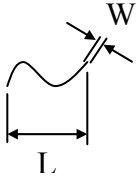
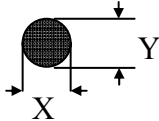
8.2.3 Visual inspection

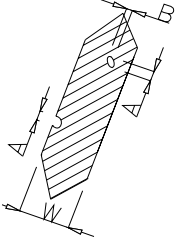
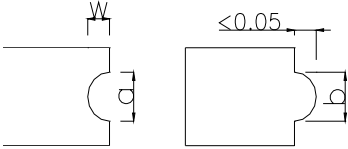
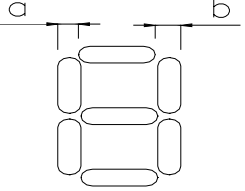
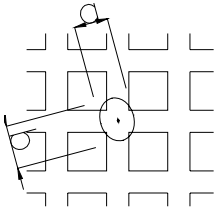
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk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

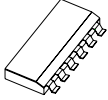


8.2.3.1 Standard of appearance inspection

Units: mm

Class	Item	Criteria																																				
Minor	Packing & Label	Outside & inside package Presence of product no., lot no., quantity																																				
Critical		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: 200px;"> <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: 200px;"> <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>2</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	$L \leq 2.5$	$0.03 < W \leq 0.05$	2	--	$0.05 < W$	As round type
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$L \leq 2.5$	$0.03 < W \leq 0.05$	2																																				
--	$0.05 < W$	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: 200px;"> <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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Class	Item	Criteria																																				

Minor	Segment deformation	<p>1.a. Pin hole on segmented display</p> <p>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> </thead> <tbody> <tr> <td>Width</td> <td>\varnothing</td> </tr> <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> </thead> <tbody> <tr> <td>Size</td> <td></td> </tr> <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</p> <p>$\varnothing = (a+b)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> </thead> <tbody> <tr> <td>Size</td> <td></td> </tr> <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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$1.5 < \varnothing \leq 2.0$	2																													
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																												

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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	$\varnothing > 0.25$	4													
On display	$\varnothing \geq 0.25$	2													
	L = 3	1													

9 RELIABILITY SPECIFICATION

9.1 RELIABILITY TESTS NORMAL TEMP

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

9.2 RELIABILITY TESTS WIDE TEMP

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

9.3 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.

10 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

TSR①2315②③128G240④⑤⑥

① **BACKLIGHT TYPE**

4 = LED backlight
6 = CCFT backlight

② **POLARIZER TYPE**

B = Transflective: light background with LED backlight
E = Transmissive: dark background with LED backlight

③ **BACKLIGHT COLOR**

G = Yellow-Green (Standard)
W = White or blank for CCFL version

④ **FLUID TYPE AND POWER SUPPLY**

H = Wide temperature range with +5VDC external negative voltage operation
W = Wide temperature range: on-board negative voltage generator

⑤ **FLUID TYPE**

F = FSTN (Film Supertwisted Nematic)
N = STN, STN-H
C = STN with on board Temperature compensation

⑥ **COLOR FOR STN FLUID**

B = Blue background (available for E polarizer type only)
G = Gray background (available for B polarizers types only)
Y = Yellow background (available for B polarizers types only)

11 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°C ± 10°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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