



**DOT MATRIX
LIQUID CRYSTAL DISPLAY
MODULE
LMG-S32A24-CCFL Serial
USER' MANUAL**

LMG-SS32A24DFNW
LMG-SF32A24DFNG

PROPOSED BY		APPROVED
Design	Approved	

SDEC TECHNOLOGY CORP.

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1. Mechanical Specification

Dot Matrix Format	320 × 240 dots
Controller IC	SED1335 or equivalent
Dimensional Outline	168.0 (W) X 109.0 (H) X 11.0 (D) mm
Viewing Area	122.0 (W) × 92.0 (H) mm
Active Viewing Area	115.17 (W) × 86.37 (H) mm
Dot Pitch	0.33 (W) × 0.33 (H) mm
Dot Size	0.36 (W) × 0.36 (H) mm
LMG-SS32A24DFNW	STN, Blue, 1/240 Duty, 1/17 Bias, 6 O'clock, CCFL Backlight (Color is White)
LMG-SF32A24DFNW	FSTN, Black, 1/240 Duty, 1/17 Bias, 6 O'clock, CCFL Backlight (Color is White)

2. Absolute Maximum Ratings:

2.1 Electrical absolute maximum rating

ITEM	SYMBOL	MIN	MAX	UNIT
Logic Circuit Supply Voltage	$V_{DD} - V_{SS}$	0	7.0	V
LCD Driver Circuit Supply Voltage	$V_{DD} - V_{EE}$	0	30.0	V
Input Voltage	V_I	V_{SS}	V_{DD}	V
Operating Temperature	T_{OP}	-20	+70	
Storage Temperature	T_{ST}	-30	+80	

2.2 Environmental absolute maximum ratings

ITEM	OPERATING		STORAGE		COMMENT
	MIN	MAX	MIN	MAX	
Ambient Temperature	-20	70	-30	80	Norm/Extended Note (1)
Humidity	Note (2)		Note (2)		Without condensation
Vibration	--	4.9m/s ²	--	19.6m/s ²	XYZ directions
Shock	--	29.4m/s ²	--	490.0m/s ²	XYZ directions

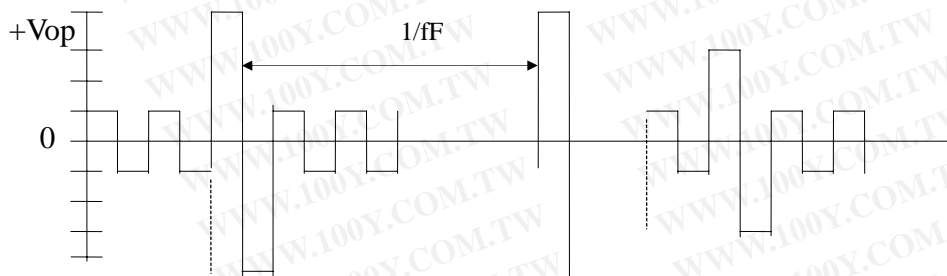
Note (1) Ta at 60 : 50 HR MAX

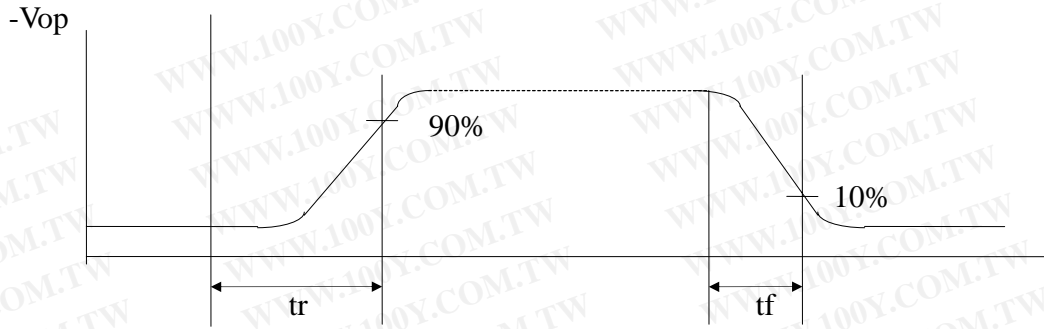
Note (2) Ta 40 : 90% RH MAX

Ta > 40 : Absolute humidity must be lower than the humidity of 90% at 40 .

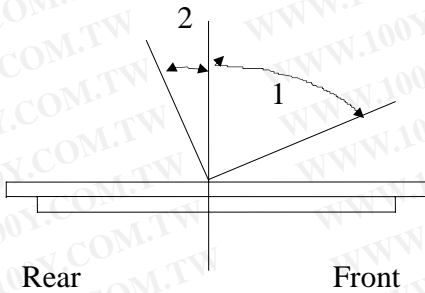
(Note 1) Definition of response time and measuring condition. Response time should be measured at the point of the most smallest response in all segments under the following condition.

- a) Temperature 25
- b) Frame frequency 70 Hz
- c) Viewing angle =0°, =0°

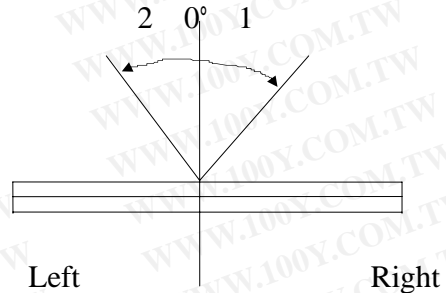




(Note 2) Definition of viewing angle
Front-Rear direction



Right-Left direction



3. Electro-optical Characteristics

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	REF.
Rise Time	Tr	25	--	330	--	mS	Note 1
Fall Time	Tf	25	--	105	--	mS	Note 1
Contrast	Cr	25	23.0	30.0	--	--	Note 3
Viewing Angle	1 / 2	25	--	45 / 35	--	DEG	Note 2
	1, 2	--	--	40	--	DEG	Note 2
Frame Frequency	Ff	25	--	70	--	Hz	--

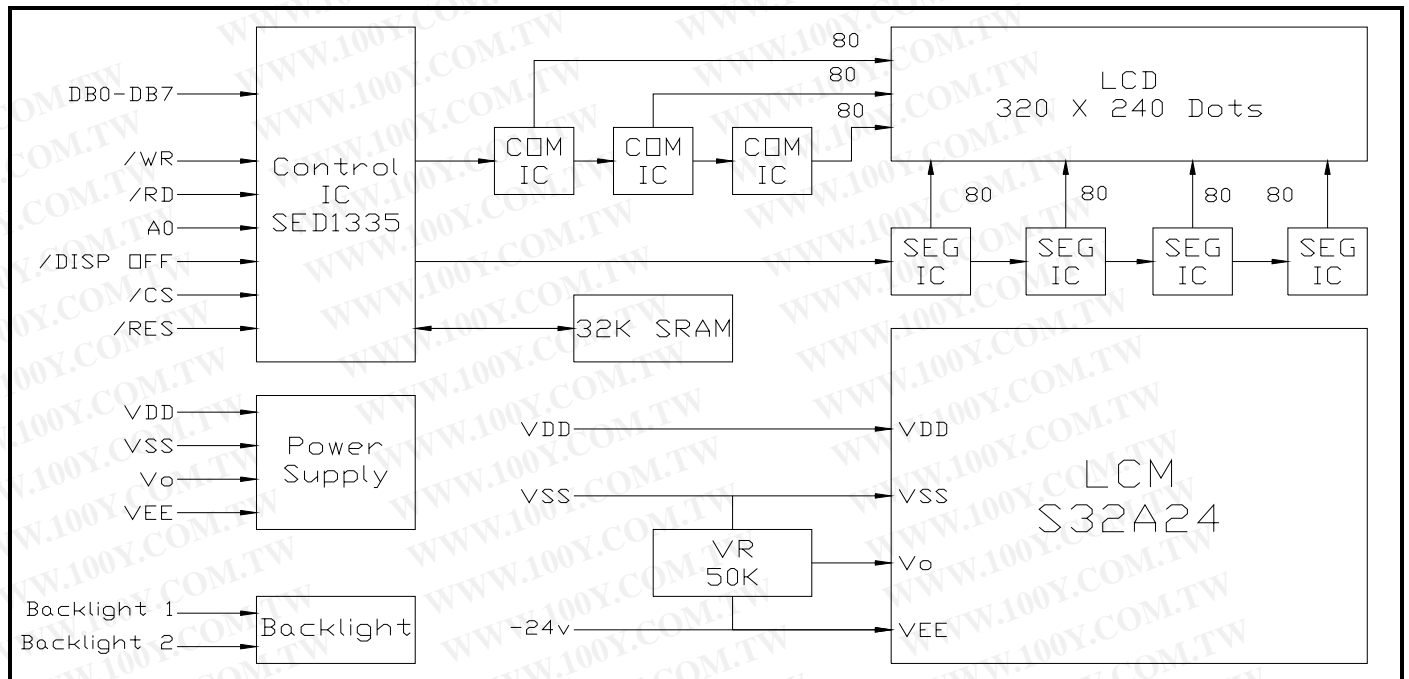
Note 1&2 : See previous page.

Note 3 : Contrast ratio is defined under the following condition.

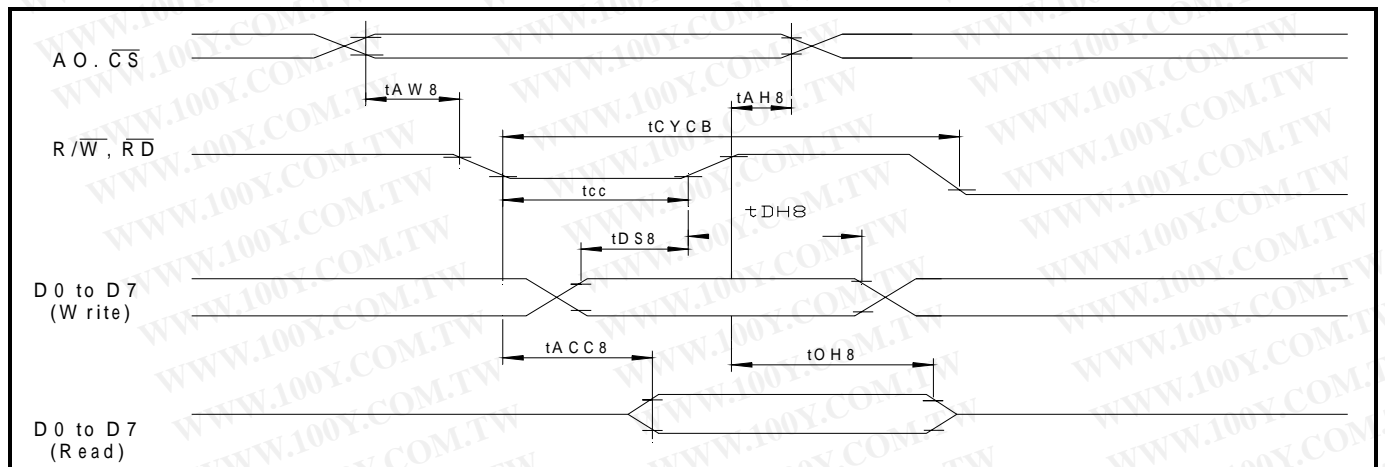
Cr = reflectance value of non-selected condition ÷ reflectance value of selected condition.

- (a) Temperature..... 25
- (b) Frame frequency..... 70 Hz
- (c) Viewing angle..... =0°, =0°
- (d) Operating voltage..... 23.5V

4. Block Diagram And Power Supply



5. Timing Characteristics



Ta = -20 to 75°C

SIGNAL	SYMBOL	PARAMETER	VDD = 4.5 to 5.5V		VDD = 2.7 to 4.5V		UNIT	CONDITION
			MIN	MAX	MIN	MAX		
A0, \overline{CS}	tAH8	Address hold time	10	—	10	—	ns	CL=100pF
	tAW8	Address setup time	0	—	0	—	ns	
\overline{WR} , \overline{RD}	tCYC8	System cycle time	See note.	—	See note.	—	ns	
	tCC	Strobe pulse width	120	—	150	—	ns	
to D7	tDH8	Data setup time	120	—	120	—	ns	
	tDH8	Data hold time	5	—	5	—	ns	
	tACC8	\overline{RD} access time	—	50	—	80	ns	
	tOH8	Output disable time	10	50	10	55	ns	

Note: For memory control and system control commands:

$$tCYC8 = 2tC + tCC + tCEA + 75 > tACV + 245$$

For all other commands:

$$tCYC8 = 4tC + tCC + 30$$

6. Electrical Characteristics

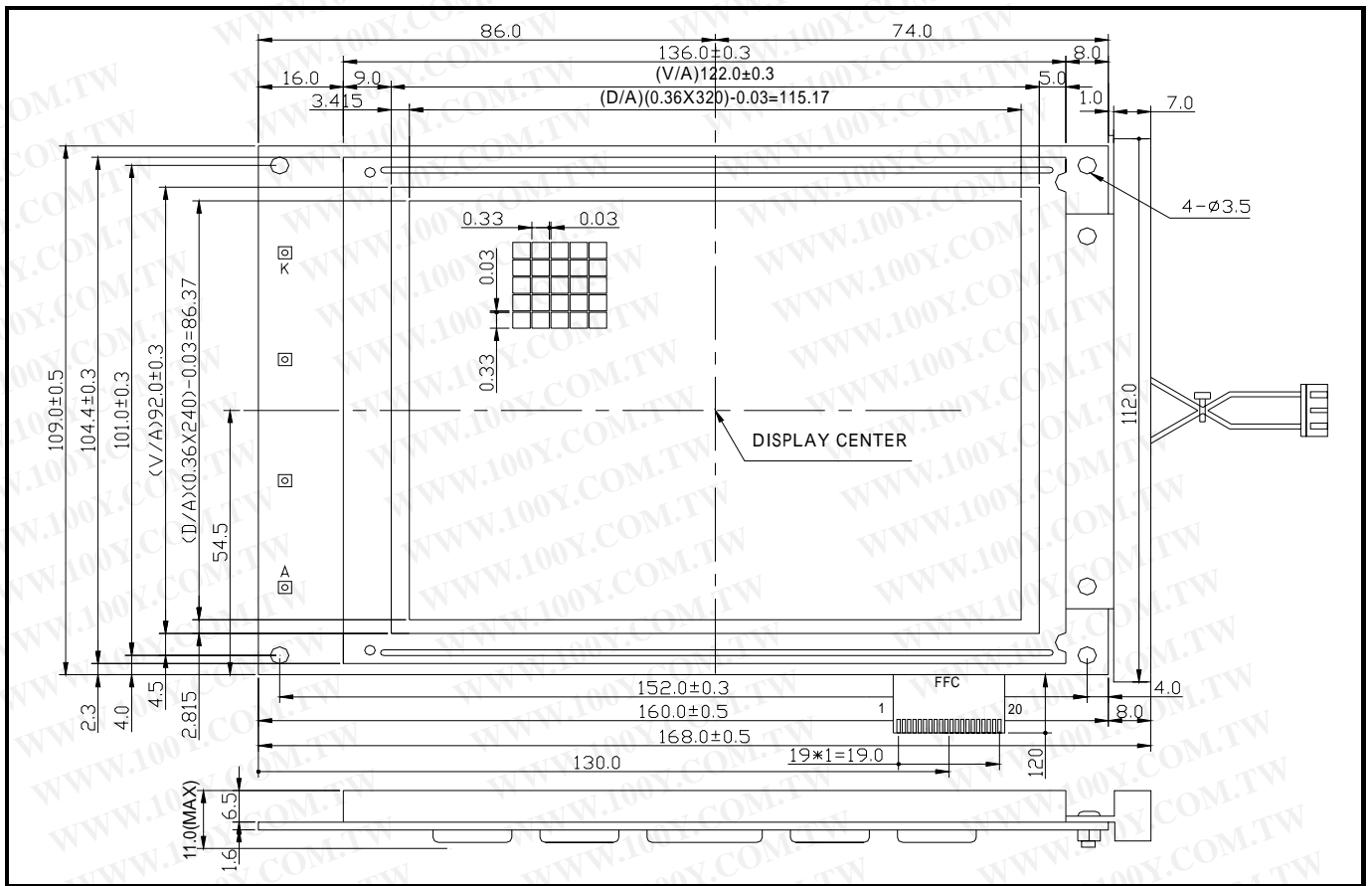
VDD = 4.5 to 5.5V, VSS = 0V, Ta = -20 to 75°C

PARAMETER	SYMBOL	CONDITION	RATING			UNIT
			MIN	TYPE	MAX	
Supply voltage	VDD		4.5	5.0	5.5	V
Register data retention voltage	VOH		2.0	—	6.0	V
Input leakage current	ILI	VI = VDD. See note 5.	—	0.05	2.0	A
Output leakage current	ILO	VI = VSS. See note 5.	—	0.10	5.0	A
Operating supply current	Iopr	See note 4.	—	11	15	mA
Quiescent supply current	IQ	Sleep mode, VOSC1 = VCS = VRD = VDD	—	0.05	20.0	μA
Oscillator frequency	fOSC	Measured at crystal, 47.5 % duty cycle.	1.0	—	10.0	MHz
External clock frequency	fCL		1.0	—	10.0	MHz
Oscillator feedback resistance	Rf	See note 6.	0.5	1.0	3.0	M
TTL						
HIGH-level input voltage	VIHT	See note 1.	0.5VDD	—	VDD	V
LOW-level input voltage	VILT	See note 1.	VSS	—	0.2VDD	V
HIGH-level output voltage	VOHT	IOH = -5.0 mA. See note 1.	2.4	—	—	V
LOW-level output voltage	VOLT	IOL = 5.0 mA. See note 1.	—	—	VSS + 0.4	V
CMOS						
HIGH-level input voltage	VIHC	See note 2.	0.8VDD	—	VDD	V
LOW-level input voltage	VILC	See note 2.	VSS	—	0.2VDD	V
HIGH-level output voltage	VOHC	IOH = -2.0 mA. See note 2.	VDD-0.4	—	—	V
LOW-level output voltage	VOLC	IOH = 1.6 mA. See note 2.	—	—	VSS + 0.4	V
Open-drain						
LOW-level output voltage	VOLN	IOL = 6.0 mA.	—	—	VSS + 0.4	V
Schmitt-trigger						
Rising-edge threshold voltage	VT+	See note 3.	0.5VDD	0.7VDD	0.8VDD	V
Falling-edge threshold voltage	VT-	See note 3.	0.2VDD	0.3VDD	0.5VDD	V

Notes:

- D0 to D7, A0, CS, RD, WR, VD0 to VD7, VA0 to VA15, VRD, VWR and VCE are TTL-level inputs.
- SEL1 is CMOS-level inputs. YD, XD0 to XD3, XSCL, LP, WF, YDIS are CMOS-level outputs.
- RES is a Schmitt-trigger input. The pulsewidth on RES must be at least 200 ms. Note that pulses of more than a few seconds will cause DC voltages to be applied to the LCD panel.
- fOSC = 10 MHz, no load (no display memory), internal character generator, 256 × 200 pixel display. The operating supply current can be reduced by approximately 1 mA by setting both CLO and the display OFF.
- VD0 to VD7 and D0 to D7 have internal feedback circuits so that if the inputs become high-impedance, the input state immediately prior to that is held. Because of the feedback circuit, input current flow occurs when the inputs are in an intermediate state.
- Because the oscillator circuit input bias current is in the order of μA, design the printed circuit board so as to reduce leakage currents.

7. Dimension Outline And Pin Connections



NO	SYMBOL	LEVEL	FUNCTION	NO	SYMBOL	LEVEL	FUNCTION
1	/RES	L	Reset signal	11	DB5	H/L	Data Bit5
2	/RD	L	DATA read	12	DB6	H/L	Data Bit6
3	/WR	L	DATA Writed	13	DB7	H/L	Data Bit7
4	/CS	L	CHIP select	14	VDD	--	VDD(+5V)
5	A0	H/L	Data/Instruction code	15	VSS	--	GND(0V)
6	DB0	H/L	Data Bit0	16	VEE	--	Negative voltage input (DC -24.0V)
7	DB1	H/L	Data Bit1	17	VO	--	Contrast Adjust
8	DB2	H/L	Data Bit2	18	/DISP OFF	--	Display off signal
9	DB3	H/L	Data Bit3	19	N.C	--	--
10	DB4	H/L	Data Bit4	20	N.C	--	--

8. Power Supply For Backlight

ITEM	CCFL Backlight
Use Inverter Type	SDEC-FL001-5A / SDEC-FL001-12A
CCFL Backlight Color	White
CCFL Backlight Input Voltage	Start Voltage = 500Vrms / Tube Voltage = 300 Vrms
CCFL Backlight Frequency	30KHz (Type)
CCFL Backlight Tube Current	5.0 mA
Inverter Input Voltage	DC +5V / DC +12V
Inverter Current Density	450 mA / 220 mA
Half-Life Time	10,000 HR.

9. The Command Set

Class	Command	Code										Hex	Command Description	Command Read Parameters	
		RD	WR	A0	D7	D6	D5	D4	D3	D2	D1			D0	No. of Bytes
System control	SYSTEM SET	1	0	1	0	1	0	0	0	0	0	0	40	Initialize device and display	8
	SLEEP IN	1	0	1	0	1	0	1	0	0	1	1	53	Enter standby mode	0
Display control	DISPLAY ON/OFF	1	0	1	0	1	0	1	1	0	0	D	58, 59	Enable and disable display and display flashing	1
	SCROLL	1	0	1	0	1	0	0	0	1	0	0	44	Set display start address and display regions	10
	CSRFORM	1	0	1	0	1	0	1	1	1	0	1	5D	Set cursor type	2
	CGRAM ADDRESS	1	0	1	0	1	0	1	1	1	0	0	5C	Set start address of character generator RAM	2
	CSRDIR	1	0	1	0	1	0	0	1	1	CD	CD	4C to 4F	Set direction of cursor Movement	0
	HDOT SCR	1	0	1	0	1	0	1	1	0	1	0	5A	Set horizontal scroll position	1
	OVLAY	1	0	1	0	1	0	1	1	0	1	1	5B	Set display overlay format	1
Drawing control	CSRW	1	0	1	0	1	0	0	0	1	1	0	46	Set cursor address	2
	CSRR	1	0	1	0	1	0	0	0	1	1	1	47	Read cursor address	2
Memory control	MWRITE	1	0	1	0	1	0	0	0	0	1	0	42	Write to display memory	--
	MREAD	1	0	1	0	1	0	0	0	0	1	1	43	Read from display memory	--

Notes:

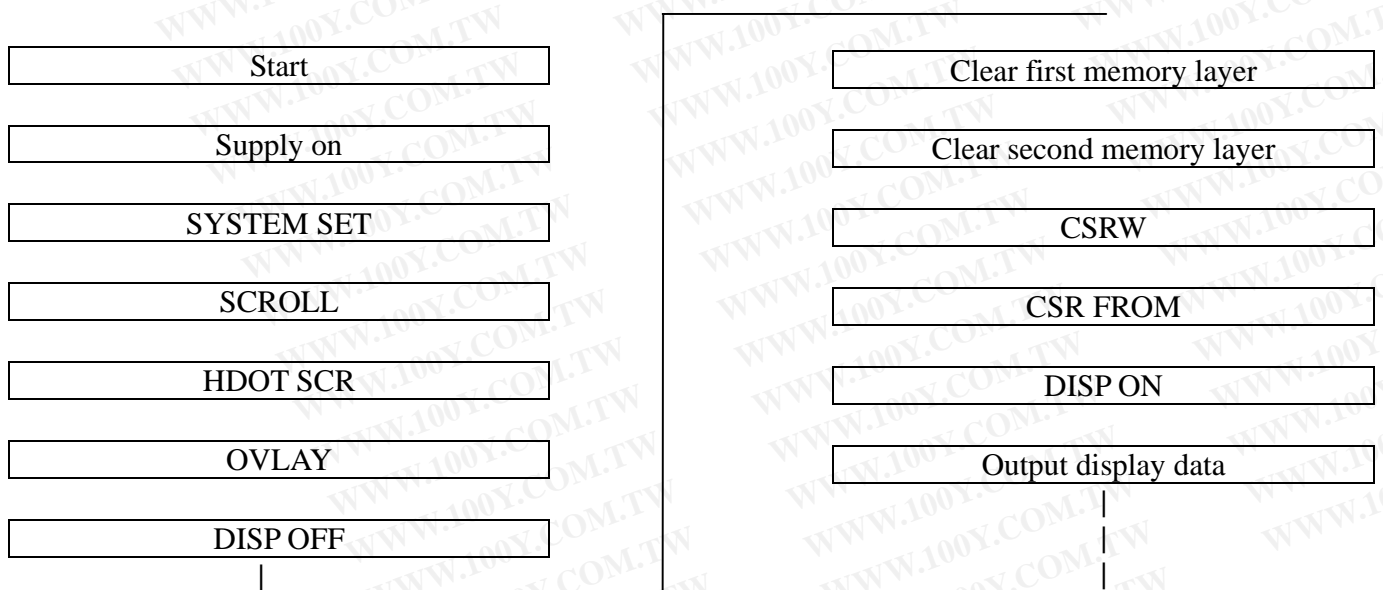
1. In general, the internal registers of the SED1335 series are modified as each command parameter is input. However, the microprocessor does not have to set all the parameters of a command and may send a new command before all parameters have been input. The internal registers for the parameters that have been input will have been changed but the remaining parameter registers are unchanged.

2-byte parameters (where two bytes are treated as 1 data item) are handled as follows:

- a. CSRW, CSRR: Each byte is processed individually. The microprocessor may read or write just the low byte of the cursor address.
- b. SYSTEM SET, SCROLL, CGRAM ADR: Both parameter bytes are processed together. If the command is changed after half of the parameter has been input, the single byte is ignored.

2. APL and APH are 2-byte parameters, but are treated as two 1-byte parameters.

10. Initialization Procedure



11. Reliability Condition

		TN Type		STN Type		
		Normal Temp.	Wide Temp.	Normal Temp.	Wide Temp.	
Viewing Angle	Horizontal	±30°	±30°	±30°	±30°	
	Vertical (mm)	-10°to 30°	-10°to 30°	-10°to 40°	-10°to 40°	
Operating Temperature		-10 to 70	-25 to 80	0 to 50	*-20 to 70	
Storage Temperature		-20 to 80	-35 to 90	-20 to 70	*-30 to 80	
High Temperature (Power Off)		240 Hours @70	240 Hours @90	240 Hours @65	240 Hours @75	
Low Temperature (Power Off)		240 Hours @-20	240 Hours @-35	240 Hours @-15	240 Hours @-25	
High Temperature (Power On)		240 Hours @70	240 Hours @80	240 Hours @60	240 Hours @70	
Low Temperature (Power On)		240 Hours @-10	240 Hours @-25	240 Hours @-10	240 Hours @-20	
High Temperature & High Humidity		55 /90%RH 240 Hours	75 /90%RH 240 Hours	45 /90%RH 240 Hours	65 /90%RH 240 Hours	
Thermal Shock 5 Cycle		A	60min@-20	60min@-35	60min@-20	60min@-30
		B	5min@25	5min@25	5min@25	5min@25
		C	60min@70	60min@90	60min@70	60min@80
Expected Lift		50,000 Hours	50,000 Hours	50,000 Hours	50,000 Hours	

*Wide temp. version may not available for some products, Please consult our sales engineer or representative.

12. Functional Test & Inspection Criteria

12.1 Sample plan

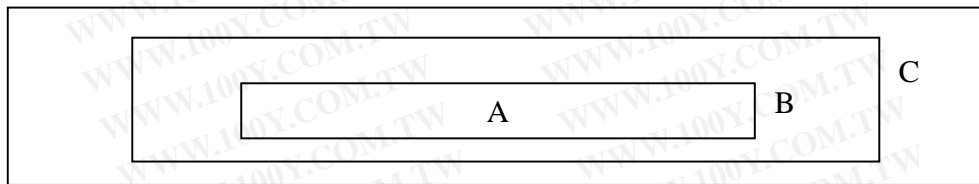
Sample plan according to MIL-STD-105D level 2, and acceptance/rejection criteria is.

Base on : Major defect : AQL 0.65 Minor defect : AQL 2.5

12.2 Inspection condition

Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lux (20W) light intensity. All direction for inspecting the sample should be within 45° against perpendicular line.

12.3 Definition of Inspection Zone in LCD



Zone A : Character / Digit area

Zone B : Viewing area except Zone A (Zone A + Zone B = minimum Viewing area)

Zone C : Outside viewing area (invisible area after assembly in customer's product)

Note : As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

12.4 Major Defect

All functional defects such as open (or missing segment), short, contrast differential, excess power consumption, smearing, leakage, etc. and overall outline dimension beyond the drawing. Are classified as major defects.

12.5 Minor Defect

Except the Major defects above, all cosmetic defects are classified as minor defects.

Item No.	Item to be Inspected	Inspection Standard			Classification of defects		
1.	Spot defect (Defects in spot from)	Zone size (mm)		Acceptable Qty		Minor	
				A	B		C
		0.15		Acceptable (clustering of spot not allowed)			Acce pta ble
		0.15	0.20	1	2		
		0.20	0.25	0	1		
		>0.25		0	0		
Remarks : for dark/white spot, size is defined as $=1/2(X+Y)$							
2.	Line defect (Defects in line form)	Size (mm)		Acceptable Qty		Minor	
		L	W	Zone			
		Length	Width	A	B		C
		Accep- table	W 0.02	Accep- table	Acce p- table		
		L 3.0	W 0.03	2			
		L>2.5	W 0.03	0			
		L 3.0	0.03<W 0.05	2			
		L>2.5	0.03<W 0.05	0			
		W>0.05	Counted as spot defect (Follows item 12.5.1)				
Remarks: The total of spot defect and line defect shall not exceed four.							
3.	Orientation defect(such as misalignment of L/C)	Not allowed inside viewing area (Zone A or Zone B)			Minor		
4.	Polarizing	12.5.4.1 Polarizer Position				Minor	
		1. Shifting in Position Should not exceed the glass outline dimension. Incomplete covering of the viewing area due to Shifting is not allowed.					
		12.5.4.2 Seratches, bubble or dent on Glass/ Polarizer/Reflector, Bubble between Polarizer & Reflector/Glass:					
		Size (mm)		Acceptable Qty			
				Zone			
				A	B		C
		0.20		Acceptable			Acce p- table
0.20<	0.50	3					
0.50<	1.00	2					
>1.00		0					

13. CG ROM Pattern

Higher 4 bit Lower 4 bit		CHARACTER PATTERN CHART(5×7DOTS+CURSOR)												
		0001	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
Lower 4-bit (D0-D3) of Character Code (Hexadecimal)	xxxx0000	■		0	Q	P	\	P		-	9	3		
	xxxx0001	■	!	1	A	Q	a	9	。	ア	チ	△		
	xxxx0010	■	"	2	B	R	b	r	「	イ	ツ	×		
	xxxx0011	■	#	3	C	S	c	s	」	ウ	テ	モ		
	xxxx0100	■	\$	4	D	T	d	t	、	エ	ト	ト		
	xxxx0101	■	%	5	E	U	e	u	・	オ	ナ	1		
	xxxx0110	■	&	6	F	V	f	v	ヲ	カ	ニ	ヨ		
	xxxx0111	■	'	7	G	W	g	w	ア	キ	ヌ	ウ		
	xxxx1000	■	(	8	H	X	h	x	イ	ウ	ネ	リ		
	xxxx1001	■	)	9	I	Y	i	y	ウ	ケ	ル			
	xxxx1010	■	*	:	J	Z	j	z	エ	コ	ン	ル		
	xxxx1011	■	+	;	K	[k	(オ	サ	ヒ	ロ		
	xxxx1100	■	,	<	L	¥	l	l	カ	シ	フ	ワ		
	xxxx1101	■	-	=	M]	m)	ユ	ズ	ン			
	xxxx1110	■	.	>	N	^	n	→	ヨ	セ	ホ	ン		
	xxxx1111	■	/	?	O	_	o	+	ウ	リ	マ	ン		



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