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LIQUID CRYSTAL DISPLAY MODULE MODEL: NMTC-S16400XFYHSAY-05C Customer's No.: None.



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Approved by	Check	ed by	Made by
微端	微端	微端	微端
2017/07/26	2017/07/26	2017/07/26	2017/07/26
連俊傑	韋有乾	洪振益	許瓊窈



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Revise Records

Rev.	Date	Contents	Written	Approved
А.	2017/07/26	Initial Edition	Jill Hsu	Danny Lien

Special Notes

Note 1.	The LCD module is compliant with RoHS.
Note 2.	
Note 3.	
Note 4.	
Note 5.	



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The Microtips Customized LCD module, model: NMTC-S16400XFYHSAY-05C is compliant with RoHS

1. General Specifications

Operating Temperature.	:	Min20°C \sim Max. 70°C
Storage Temperature.	:	Min30°C \sim Max. 80°C
Display Format	:	16 characters x 4 lines
Display Fonts	:	5 x 7 dots + cursor (1 character)
Viewing Area	:	61.8 (W) x 25.2 (H) mm
Outline Dimensions	:	87.0(W) x 60.0 (H) x 14.0 max. (D) mm
Weight	:	N/A
LCD Type	:	STN / Yellow Mode / Transflective
Viewing Direction	:	6:00H
Backlight	:	Array type LED Backlight (Yellow – Green)
LSI	:	ST 7066
Drawings	:	As attached drawings



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2. <u>Electrical Specifications</u>

2.1 Absolute Maximum Ratings

					$V_{SS} = 0V$
Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage (Logic)	$V_{DD} - V_{SS}$		- 0.3	7.0	V
Supply Voltage (LCD Drive)	V _{LCD}		V _{DD} -15.0	$V_{DD} + 0.3$	V
Input Voltage	VI		- 0.3	$V_{DD} + 0.3$	V

2.2 DC Characteristics

 $Ta = 25^{\circ}C, V_{SS} = 0V$

Parameter	Symbol	Conditions	Min.	Тур.	Max.	Units
Supply Voltage (Logic)	$V_{DD} - V_{SS}$		4.5		5.5	V
Supply Voltage (LCD Drive)	$V_{DD} - V_O$		Shown in 3	.1		V
High Level (Input Voltage)	V_{IH}	$V_{DD} = 5.0 V$	2.2		V _{DD}	V
Low Level (Input Voltage 0	V _{IL}	$V_{DD} = 5.0 V$	-0.3		0.6	V
High Level (Output Voltage)	V _{OH}	$I_{OH} = -0.205 mA$	2.4		V _{DD}	V
Low Level (Output Voltage)	V _{OL}	$I_{0 L} = 1.2 mA$	0		0.4	V
Supply Current	I _{DD}	$V_{DD} - V_{SS} = 5.0V$		1.5	5.0	mA

 $Ta = 25^{\circ}C, V_{SS} = 0V$

Parameter	Symbol	Conditions	Min.	Тур.	Max.	Units
Supply Voltage (Logic)	$V_{DD} - V_{SS}$		2.7		4.5	V
Supply Voltage (LCD Drive)	$V_{DD} - V_O$	Shown in 3.1				V
High Level (Input Voltage)	V _{IH}	$V_{DD} = 3.0 V$	$0.7 V_{DD}$		V _{DD}	V
Low Level (Input Voltage)	V _{IL}	$V_{DD} = 3.0 V$	-0.3		0.55	V
High Level (Output Voltage)	V _{OH}	$I_{OH} = -0.1 \text{mA}$	$0.75 V_{DD}$		V _{DD}	V
Low Level (Output Voltage)	V _{OL}	$I_{OL}=0.1 \text{mA}$	0		$0.2 \ V_{DD}$	V
Supply Current	I _{DD}	$V_{DD} - V_{SS} = 5.0V$		1.5	5.0	mA



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2.3 AC Characteristics

				$V_{DD} = 4$	$\sim 5V \sim 5.5V$
Parameter	Symbol	Conditions	Min.	Max.	Units
Enable Cycle Time	t _{CYC}	Fig.1, 2	500		ns
Enable Pulse Width	$\mathrm{PW}_{\mathrm{EH}}$	Fig.1, 2	230		ns
Enable Rise / Fall Time	$t_{\rm Er},t_{\rm Ef}$	Fig.1, 2		20	ns
Address Setup Time	t _{AS}	Fig.1, 2	40		ns
Address Hold Time	$t_{\rm AH}$	Fig.1, 2	10		ns
Write Data Setup Time	$t_{\rm DSW}$	Fig.1	80		ns
Write Data Hold Time	t _{DHW}	Fig.1	10		ns
Read Data Delay Time	t _{DDR}	Fig.2		120	ns
Read Data Hold Time	t _{DHR}	Fig.2	5		ns

V _{DD} =	= 2.7V	$\sim 4.5 V$
-------------------	--------	--------------

Parameter	Symbol	Conditions	Min.	Max.	Units
Enable Cycle Time	t _{CYC}	Fig.1, 2	1000		ns
Enable Pulse Width	$\mathrm{PW}_{\mathrm{EH}}$	Fig.1, 2	450		ns
Enable Rise / Fall Time	$t_{\rm Er},t_{\rm Ef}$	Fig.1, 2		25	ns
Address Setup Time	t _{AS}	Fig.1, 2	60		ns
Address Hold Time	$t_{\rm AH}$	Fig.1, 2	20		ns
Write Data Setup Time	t _{DSW}	Fig.1	195		ns
Write Data Hold Time	t _{DHW}	Fig.1	10		ns
Read Data Delay Time	t _{DDR}	Fig.2		360	ns
Read Data Hold Time	t _{DHR}	Fig.2	5		ns



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Fig.1 Write Operation Timing



Fig.2 Read Operation Timing



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2.4 Lighting Specifications

2.4.1 Absolute Maximum Ratings

				$Ta = 25^{\circ}C$
Parameter	Symbol	Conditions	Max.	Units
Forward Current	$I_{\rm F}$		440	mA
Reverse Voltage	V _R		10.0	V
LED Power Dissipation	P _D		1.95	W

2.4.2 Operating Characteristics

						$Ta = 25^{\circ}C$
Parameter	Symbol	Conditions	Min.	Тур.	Max.	Units
Forward Voltage	$V_{\rm F}$	$I_F = 220 mA$		4.1	4.4	V
Peak Emission Wavelength	λ_{P}	$I_F = 220 mA$	570	573	575	Nm
Luminance of Backlight Surface	L	$I_F = 220 mA$	160	290		cd/m ²
Luminous Tolerance		$I_F = 220 mA$			30	%
Chromaticity Coordinates	Х	$I_F = 220 \text{mA}$	0.43	0.46	0.49	
	Y	$I_F = 220 \text{mA}$	0.50	0.52	0.56	

Note 1: Luminance tolerance = (Max. - Min. / Max.) x 100%

Note 2: The driving condition above is based on Backlight A,K.

2.4.3 Schematics Related





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3. **Optical Specifications**

3.1 LCD Driving Voltage

Parameter	Symbol	Conditions	Min.	Тур.	Max.	Units
Recommended LCD Driving Voltage Note 1	$V_{DD} - V_O$	Ta = -20 °C	4.54	4.63	4.74	V
		Ta = 25 °C	4.47	4.57	4.67	V
		Ta = 70 °C	4.18	4.28	4.38	V

Note 1: Voltage (Applied actual waveform to LCD) for the best contrast. The range of minimum and maximum shows tolerance of the operating voltage. The specified contrast ratio and response time are not guaranteed over the entire range.

3.2 Optical Characteristics

Parameter		Symbol	Conditions	Min.	Тур.	Max.	Units
Contrast Ratio Note 1		CR	$\theta = 0^{\circ}, \ \phi = 0^{\circ}$		5		
Viewing Angle		Front – Back	$ \Theta_f - \Theta_{b,} \phi = 0^{\circ} $	-30	to	+15	deg.
(Show	wn in 3.3)	Left – Right	$ \Theta_l - \Theta_{r,} \phi = 0^\circ $	-20	to	+20	deg.
Response	Rise Note 2	T _{ON}			200	400	ms
Time	Decay Note 3	T _{OFF}			160	320	ms

Note 1: Contrast ratio is defined as follows.

 $CR = L_{OFF} / L_{ON}$

L_{ON}: Luminance of the ON segments, L_{OFF}: Luminance of the OFF segments

- Note 2: The time that the luminance level reaches 90% of the saturation level from 0% when ON signal is applied.
- Note 3: The time that the luminance level reaches 10% of the saturation level from 100% when OFF signal is applied.
- Note 4: Definition of Driving Voltage V_D. Assuming that the typical driving waveforms shown below are applied to the LCD Panel at /A Duty 1/B Bias (A: Duty Number, B: Bias Number). Driving voltage V_D is defined s follows: V_D = (Vth1+Vth2) / 2
 - Vth1: The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the ON signal is applied to.
 - Vth2: The voltage VO-P that should provide 50% of the saturation level in the luminance at the segment which the OFF signal is applied to.





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3.3 Definition of Viewing Angle and Optimum Viewing Area



3.4 Definition of Viewing Angle θ_f and θ_b



Above are not always the same.

3.5 Definition of Contrast C, C= Brightness of selected dot (B1)/Brightness of unselected dot (B2)





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4. <u>I/O Terminal</u>

4.1 Pin Assignment

No.	Symbol	Level	Function
1.	VSS		Power Supply (0V, GND)
2.	VDD		Power Supply for Logic
3.	VEE (Vo)		Power Supply for LCD Drive
4.	RS	H / L	Register Select Signal
5.	R/W	H / L	Read / Write Select Signal H: Read L: Write
6.	Е	H / L	Enable Signal (No pull – up Resister)
7.	DB0	H / L	Data Bus Line / Non – connection at 4 – bit operation
8.	DB1	H / L	Data Bus Line / Non – connection at 4 – bit operation
9.	DB2	H / L	Data Bus Line / Non – connection at 4 – bit operation
10.	DB3	H / L	Data Bus Line / Non – connection at 4 – bit operation
11.	DB4	H / L	Data Bus Lin
12.	DB5	H / L	Data Bus Line
13.	DB6	H / L	Data Bus Line
14.	DB7	H / L	Data Bus Line

4.2 Example of Power Supply

It is recommended to apply a potentiometer for the contrast adjust due to the tolerance of the driving voltage and its temperature dependence.







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4.3 Block Diagram





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5. <u>Reliability Test</u>

5.1 Test Item

No change on display and in operation under the following test condition.

No.	Test Item	Description	Condition	Note
1.	High Temperature (Operation)	Durability test under long time high temperature with electrical stress (voltage, current)	$70^{\circ}C \pm 2^{\circ}C$ 96hrs	
2.	High Temperature (Storage)	Durability test under long time high temperature storage	$80^{\circ}C \pm 2^{\circ}C 96hrs$	4
3.	Low Temperature (Operation)	Durability test under long time low temperature with electrical stress (voltage, current)	$-20^{\circ}C \pm 2^{\circ}C$, 96hrs	3
4.	Low Temperature (Storage)	Durability test under long time low temperature storage	$-30^{\circ}C \pm 2^{\circ}C$, 96hrs	3, 4
5.	Damp Proof Test	Durability test under long time high temperature and high humidity	40°C ± 2°C, 90 ~ 95% RH 96hrs	3, 4
6.	Vibration Test	Total fixed amplitude: 1.5 mm Vibration frequency: $10 \sim 55$ Hz One cycle 60 seconds to 3 directions of X, Y, Z for each 15 minutes		5
7.	Drop Test	To be measured after dropping from 60cm high in packing state. F E G B A C E B A C E C E C E E C E C E E E C E E E C E E E E E C E E E E E E C E E E E E E C E E E E E E E E	n on the concrete surface od corner dropping nce e: once	

Note 1: Unless otherwise specified, tests will be conducted under the following condition,

Temperature :
$$25^{\circ}C \pm 2^{\circ}C$$

Humidity
$$: 65\% \pm 5\%$$

Note 2: Unless otherwise specified, tests will be not conducted under functioning state.

Note 3: No dew condensation to be observed.

Note 4: The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.

Note 5: Vibration test will be conducted to the product itself without putting it in a container.



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5.2 Judgment Standard

Failure Mode			Т	est Ite	m			Judgment Standard	
	1	2	3	4	5	6	7		
Orientation	*	*	*	*	*			No remarkable degradation of appearance under bias/ non-bias condition	
Current Value (IAC)	*	*	*	*	*			No remarkable increase	
Contrast	*		*	*	*			No remarkable poor contrast	
Domain	*	*	*	*	*			Less than 20% of all dots have reverse tilt of more than on third of one dot area.	
Bubble (Inside Cell)	*	*	*	*	*	*		As per "Appearance Standard" (Note. In- cluding one which disappear after 25°C 2H)	
Polarizer	*				*	*		As per "Appearance Standard" no remarkable appearance change	
Glass Damage							*	As per "Appearance Standard"	

Note. 1. * is strong linkage between Failure Mode and Test Item.

2. Number of Test Item should be referred to former page.

3. Judgment and Standard value should be fixed by other inspection standard and criteria samples.



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6. Appearance Standards

6.1 Inspection Conditions

The LCD shall be inspected under 40W white fluorescent light. The distance between the eyes and the sample shall be more than 30cm. All directions for inspecting the sample should be within 45° against perpendicular line.



6.2 Definition of Applicable Zones



A Zone: Active display area B Zone: Area from outside of "A Zone" to validity viewing area C Zone: Rest parts A Zone + B Zone = Validity viewing area



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6.3 Standards

No.	Parameter	Criteria							
1.	Black and White Spots, Foreign Substances	(1) Round Shape Zone Dimension (mm) $D \leq 0.1$ $0.1 < D \leq 0.2$ $0.2 < D \leq 0.25$ $0.25 < D \leq 0.3$ 0.3 < D D = (Long + Short) / 2 *: Disrest (2) Line Shape $Zone$ Zone X (mm) $Y (mm) 0.03 \geq W2.0 \geq L 0.05 \geq W1.0 \geq L 0.1 \geq W$ $0.1 < WX: Length Y: Width *: Disrest$	Acc A * 3 2 0 0 0 0 0 0 2 0 2 0 2 0 0 cgard	eptable Num B C C C C C C C C C C C C C C C C C C	C *				
2.	Air Bubbles (between glass & polarizer)	ZoneDimension (mm) $D \leq 0.3$ $0.3 < D \leq 0.4$ $0.4 < D \leq 0.6$ $0.6 < D$ *: DisregardTotal defects shall not exceed 3.	Acc A * 3 2 0	eptable Num B * 3 0	nber C * * *				

To be continued.....



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7. Handling and Precautions

The Following precautions will guide you in handling our product correctly.

- 1 Liquid crystal display devices
 - 1.1 The liquid crystal display device panel used in the liquid crystal display module is made of plate glass. Avoid any strong mechanical shock. Should the glass break handle it with care.
 - 1.2 The polarizer adhering to the surface of the LCD is made of a soft material. Guard against scratching it.
- 2 Care of the liquid crystal display module against static electricity discharge.
 - 2.1 When working with the module, be sure to ground your body and any electrical equipment you may be using. We strongly recommend the use of anti static mats (made of rubber), to protect work tables against the hazards of electrical shock.
 - 2.2 Avoid the use of work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
 - 2.3 Slowly and carefully remove the protective film from the LCD module, since this operation can generate static electricity.
- 3 When the LCD module alone must be stored for long periods of time:
 - 3.1 Protect the modules from high temperature and humidity.
 - 3.2 Keep the modules out of direct sunlight or direct exposure to ultra-violet rays.
 - 3.3 Protect the modules from excessive external forces.
- 4 Use the module with a power supply that is equipped with an over current protector circuit, since the module is not provided with this protective feature.
- 5 Do not ingest the LCD fluid itself should it leak out of a damaged LCD module. Should hands or clothing come in contact with LCD fluid, wash immediately with soap.
- 6 Conductivity is not guaranteed for models that use metal holders where solder connections between the metal holder and the PCB are not used. Please contact us to discuss appropriate ways to assure conductivity.



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8. <u>Warranty</u>

This product has been manufactured to your company's specifications as a part for use in your company's general electronic products. It is guaranteed to perform according to delivery specifications. For any other use apart from general electronic equipment, we cannot take responsibility if the product is used in medical devices, nuclear power control equipment, aerospace equipment, fire and security systems, or any other applications in which there is a direct risk to human life and where extremely high levels of reliability are required. If the product is to be used in any of the above applications, we will need to enter into a separate product liability agreement.

- 1 13months guarantee starts from the date code.
- 2 We cannot accept responsibility for any defect, which may arise from additional manufacturing of the product (including disassembly and reassembly), after product delivery.
- 3 We cannot accept responsibility for any defect, which may arise after the application of strong external force to the product.
- 4 We cannot accept responsibility for any defect, which may arise due to the application of static electricity after the product has passed your company's acceptance inspection procedures.
- 5 We cannot accept responsibility for industrial property, which may arise through the use of your product, with exception to those issues relating directly to the structure or method of manufacturing of our product. Microtips-origin longer than one year from Microtips production.

9. Dimensional Outlines

• See the next page.....



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