

# AZ DISPLAYS, INC.

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*COMPLETE LCD SOLUTIONS*

## **SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY**

PART NUMBER:  
DATE:

ACM1602U Series  
August 16, 2004

# AZ DISPLAYS, INC.

## 1. FEATURES

- \* Display mode : STN
- \* Background: : Gray or Yellow
- \* Polarizer: : Reflective, Transflective, or Transmissive
- \* Display Format : 16 X 2 Characters
- \* IC : NOVATEK NT7605H-BDT01
- \* Driving Method : 1/16 Duty, 1/5 Bias
- \* Viewing Direction : Top or Bottom
- \* Backlight : None

## 2. MECHANICAL SPECIFICATIONS

Item	Specification	Unit
Module Size	65.0(W) X 27.7(H) X 1.85max(T)	mm
Viewing Area	61.0MIN (W) X 15.7MIN(H)	mm
Character Font	5 X 7 Dots	
Character Size	2.95(W) X 5.15(H)	mm
Dot Pitch	0.60(W) X 0.65(H)	mm
Dot Size	0.55(W) X 0.60(H)	mm

## 3. ELECTRICAL SPECIFICATIONS

### 3-1. Absolute Maximum Ratings (V<sub>SS</sub>=0V)

Item	Symbol	Standard Value			Unit
		Min.	Typ.	Max.	
Supply Voltage For Logic	V <sub>DD</sub> -V <sub>SS</sub>	-0.3	-	7.0	V
Supply Voltage For LCD Drive	V <sub>DD</sub> -V <sub>L</sub>	0	-	V <sub>DD</sub> +0.3	V
Input Voltage	V <sub>I</sub>	0.33	-	V <sub>DD</sub> +0.3	V
Operating Temp.	T <sub>OP</sub>	-20	-	+70	°C
Storage Temp.	T <sub>ST</sub>	-30	-	+80	°C

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## 3. ELECTRICAL SPECIFICATIONS (Continued)

### 3-2. Electrical Characteristics (V<sub>SS</sub>=0V)

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit	
Logic Supply Voltage	V <sub>DD</sub> – V <sub>SS</sub>	T <sub>a</sub> =0~50°C	4.5	5.0	5.5	V	
LCD Drive Voltage (Recommended Voltage)	V <sub>DD</sub> – V <sub>L</sub>	T <sub>a</sub> =25°C	4.0	4.4	4.9	V	
Input Voltage	“H” Level	V <sub>IH</sub>	V <sub>DD</sub> =5V+/- 5%	0.8 V <sub>DD</sub>	-	V <sub>DD</sub>	V
	“L” Level			V <sub>IL</sub>	-0.3	-	0.2 V <sub>DD</sub>
Output Voltage	“H” Level	V <sub>OH</sub>	V <sub>DD</sub> =5V+/- 5%	V <sub>DD</sub> -0.6	-	-	V
	“L” Level			V <sub>OL</sub>	-	-	GND+0.6
Current Consumption	I <sub>DD</sub>	V <sub>DD</sub> =5V+/- 5% V <sub>DD</sub> -V <sub>0</sub> =4.5V	-	1.25	2.0	mA	
Frame Frequency	-	V <sub>DD</sub> =5V	-	84.3	-	HZ	

NOTE: 1) Duty Ratio=1/16, Bias Ratio=1/5

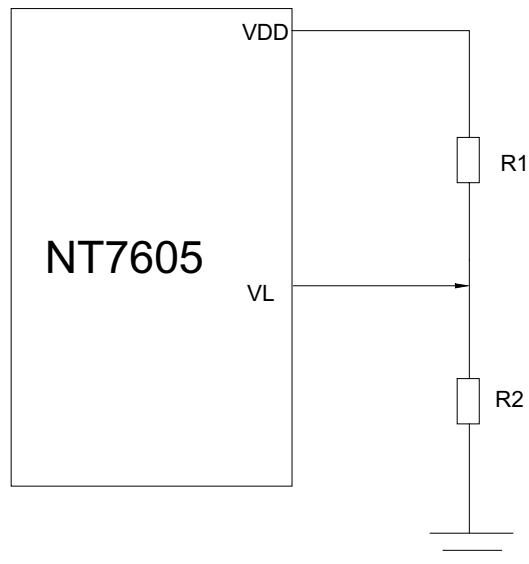
2) Measuring in Dots ON-state

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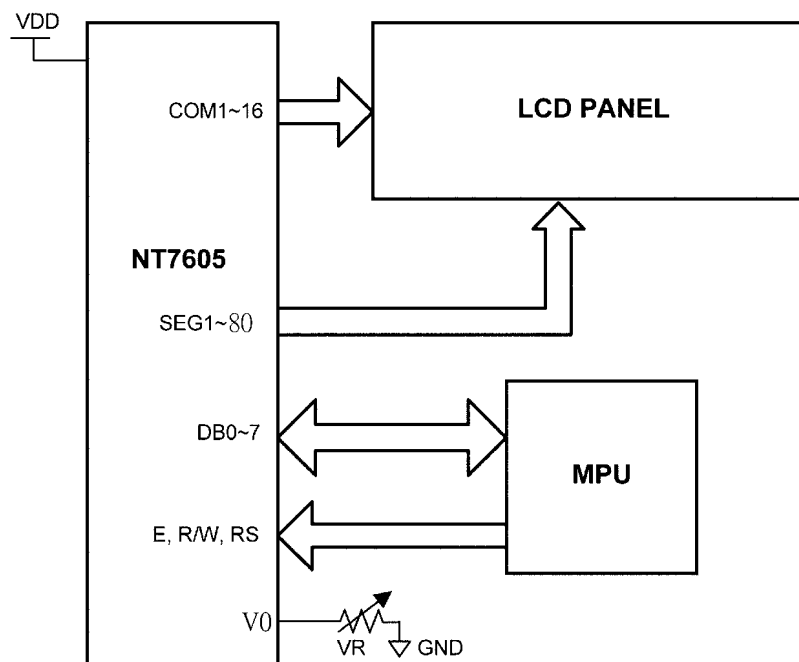
## 4. BLOCK DIAGRAM AND POWER SUPPLY

### 4-1. POWER SUPPLY



Note :  $V_{op} = V_{DD} - V_L$  ;  $R1 + R2 = 10K\text{-}\Omega \sim 20K\text{-}\Omega$

### 4-2. BLOCK DIAGRAM



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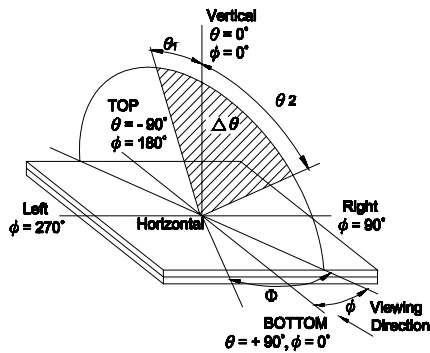
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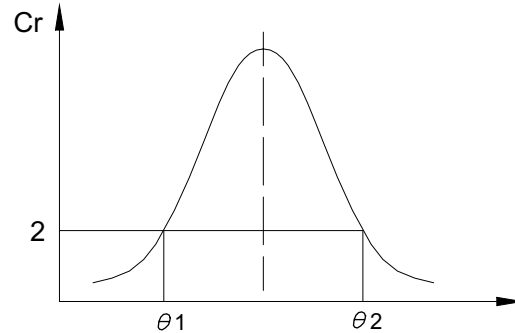
## 5. ELECTRO – OPTICAL CHARACTERISTICS

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit	Conditions	Note
Viewing Angle	$\theta_2 - \theta_1$	25C	30	100	-	Deg.	-	1,2
	$\phi$		80	93	-			
Contrast Ratio	Cr	25C	2	3.38	5.67	-	$\theta = 0^\circ$ $\phi = 0^\circ$	3
Response Time(rise)	Tr	25C	-	64	250	ms	$\theta = 0^\circ$ $\phi = 0^\circ$	4
		0C	-	950	1150			
Response Time(fall)	Tf	25C	-	120	250	ms	$\theta = 0^\circ$ $\phi = 0^\circ$	4
		0C	-	950	1150			

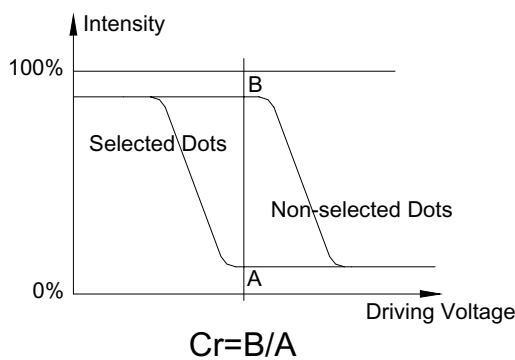
Note1 . Definition of Angle  $\theta$  &  $\phi$



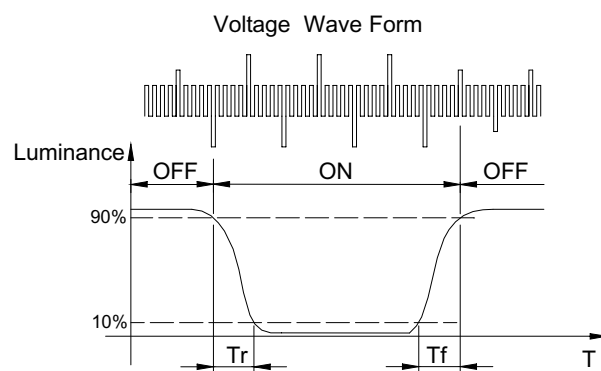
Note2. Definition of Viewing Angle  $\theta_1$  &  $\theta_2$



Note3 . Definition of Contrast Cr



Note4. Definition of Optical Response



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## 6. TERMINAL PIN FUNCTION

### 6-1. Interface Pin Function Description

Pin NO.	Symbol	I / O	Functions
1	VSS	P	Power supply (VSS=0V)
2	VL	P	LCD Operating Voltage
3	VDD	P	+5V
4	RS	I	Register select signal
5	R/W	I	Read/Write control signal
6	E	I	Enable signal (Schmitt trigger input)
7	DB0	I/O	Lower 4 tri-state bi-directional data bus for transmitting data between MPU and NT7605. Not used during 4-bit operation.
8	DB1		
9	DB2		
10	DB3		
11	DB4	I/O	Higher 4 tri-state bi-directional data bus for transmitting data between MPU and NT7605. DB7 is also used as busy flag.
12	DB5		
13	DB6		
14	DB7		

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## 7.TIMING CHARACTERISTICS

Symbol	Parameter	Min.	Typ.	Max.	Unit	Conditions
t <sub>CYCE</sub>	Enable Cycle Time	500	-	-	ns	Figure 2
t <sub>WHE</sub>	Enable "H" Level Pulse Width	300	-	-	ns	Figure 2
t <sub>RE</sub> , t <sub>FE</sub>	Enable Rise/Fall Time	-	-	25	ns	Figure 2
t <sub>AS</sub>	RS, R/W Setup Time	60 <sup>1</sup>	-	-	ns	Figure 2
		100 <sup>2</sup>				
t <sub>AH</sub>	RS, R/W Address Hold Time	10	-	-	ns	Figure 2
t <sub>DS</sub>	Data Output Delay	100	-	-	ns	Figure 2
t <sub>DHW</sub>	Data Hold Time	10	-	-	ns	Figure 2

Notes: 1: 8-bit operation mode  
2: 4-bit operation mode

### Read Operation

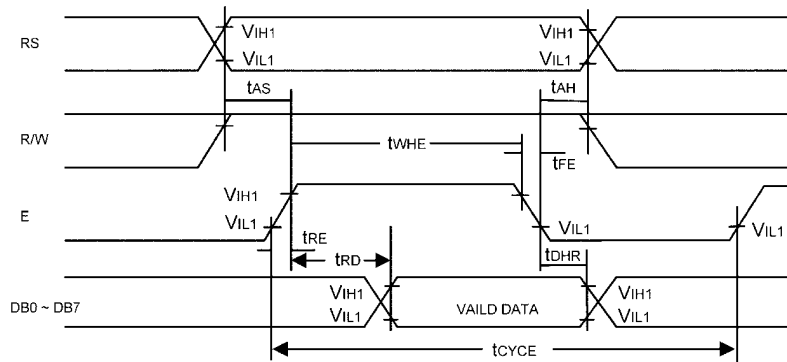


Figure 1. Bus Read Operation Sequence  
(Reading out data from NT7605 to MPU)

### Write Operation

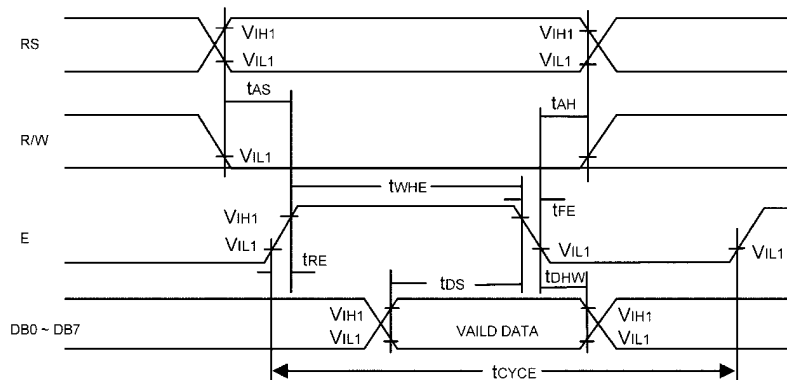


Figure 2. Bus Write Operation Sequence  
(Writing data from MPU to NT7605)

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## 8. INSTRUCTION SET

### 8-1. Instruction Table

Instruction	Code										Function	Execution time (max) (fosc = 250KHz)	
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0			
Display Clear	0	0	0	0	0	0	0	0	0	0	1	Clear entire display area, Restore display from shift, and load address counter with DD RAM address 00H.	1.64ms
Display/ Cursor Home	0	0	0	0	0	0	0	0	0	1	*	Restore display from shift and load address counter with DD RAM address 00H.	1.64ms
Entry Mode Set	0	0	0	0	0	0	0	0	1	I/D	S	Specify direction of cursor movement and display shift mode. This operation takes place after each data transfer (read/write).	40µs
Display ON/OFF	0	0	0	0	0	0	0	1	D	C	B	Specify activation of display (D) cursor (C) and blinking of character at cursor position (B).	40µs
Display/ Cursor Shift	0	0	0	0	0	0	1	S/C	R/L	*	*	Shift display or move cursor.	40µs
Function Set	0	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL), number of display line (N), and character font (F).	40µs
RAM Address Set	0	0	0	1	ACG						Load the address counter with a CG RAM address. Subsequent data access is for CG RAM data.	40µs	
DD RAM Address Set	0	0	1	ADD						Load the address counter with a DD RAM address. Subsequent data access is for DD RAM data.	40µs		
Busy Flag/ Address Counter Read	0	1	BF	AC						Read Busy Flag (BF) and contents of Address Counter (AC).	1µs		
CG RAM/ DD RAM Data Write	1	0	Write data						Write data to CG RAM or DD RAM.	40µs			
CG RAM/ DD RAM Data Read	1	1	Read data						Read data from CG RAM or DD RAM.	40µs			
	I/D = 1 : Increment S = 1 : Display Shift On D = 1 : Display On C = 1 : Cursor Display On B = 1 : Cursor Blink On S/C = 1 : Shift Display R/L = 1 : Shift Right DL = 1 : 8-Bit N = 1 : Dual Line F = 1 : 5x10 dots BF = 1 : Internal Operation BF = 0 : Ready for Instruction										I/D = 0 : Decrement  S/C = 0 : Move Cursor R/L = 0 : Shift Left DL = 0 : 4-Bit N = 0 : Signal Line F = 0 : 5x8 dots	DD RAM : Display Data RAM CG RAM : Character Generator RAM ACG : Character Generator RAM Address ADD : Display Data RAM Address AC : Address Counter	

Note 1: Symbol "\*" signifies an insignificant bit (disregard).

Note 2: Correct input value for "N" is predetermined for each model.

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## 9. FONT TABLE

		Higher 4-bit (D4 to D7) of Character Code (Hexadecimal)																			
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F				
Lower 4-bit (D0 to D3) of Character Code (Hexadecimal)	0	CG RAM (1)			0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
	1	CG RAM (2)		!	1	A	2	a													
	2	CG RAM (3)		"	2	R	r														
	3	CG RAM (4)		#	3	S	s														
	4	CG RAM (5)		*	4	T	t														
	5	CG RAM (6)		%	5	E	e														
	6	CG RAM (7)		@	6	F	f														
	7	CG RAM (8)		'	7	G	g														
	8	CG RAM (1)		@	H	X	x														
	9	CG RAM (2)		>	9	Y	y														
	A	CG RAM (3)		*#	J	Z	z														
	B	CG RAM (4)		+;	K	X	x														
	C	CG RAM (5)		.	<	L	I	l													
	D	CG RAM (6)		-	=	M	I	m													
	E	CG RAM (7)		.	>	N	n	+													
	F	CG RAM (8)		/	?@	O	o	+													

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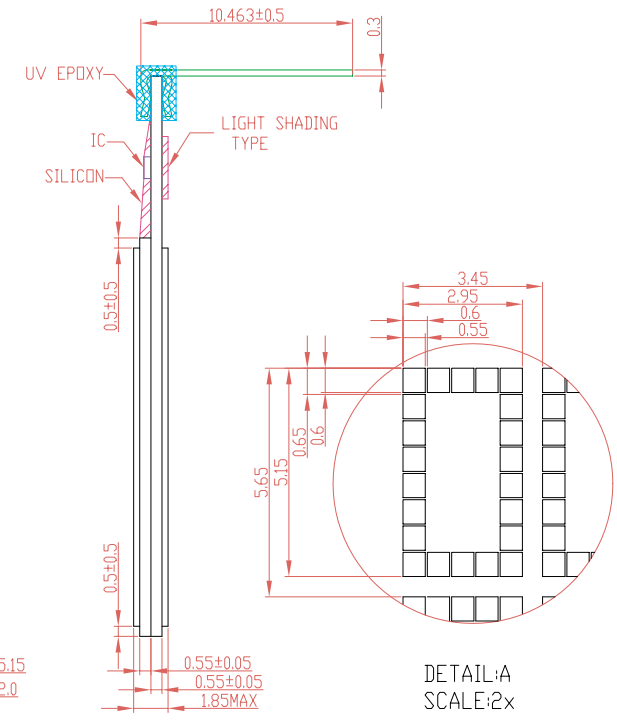
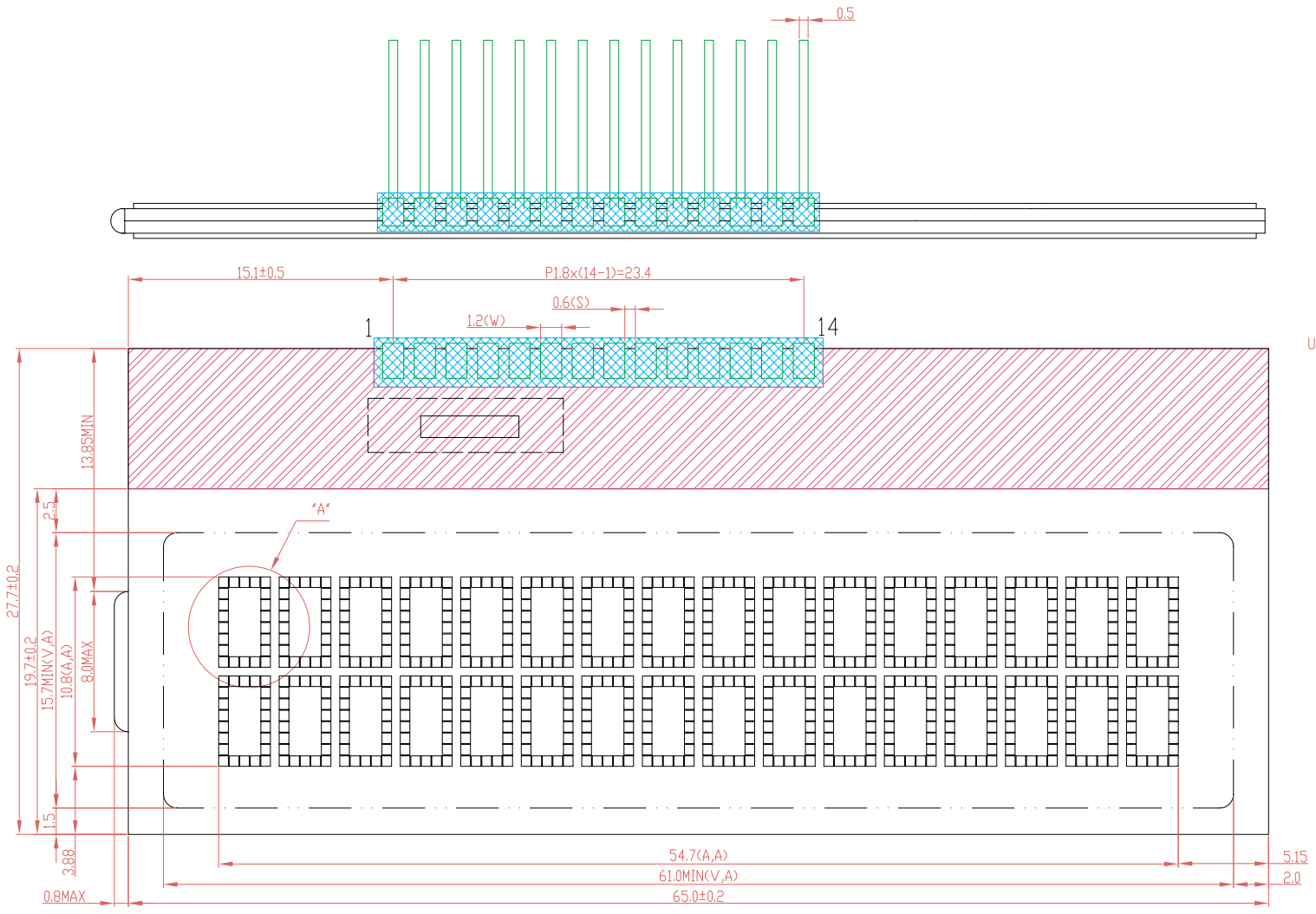
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REV	REVISION RECORD	DATE	APPROVED	NAME
△				



DETAIL:A  
SCALE:2x

NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SYMBOL	VSS	VL	VDD	RS	RW	E	DB0	DB1	DB2	DB3	DB4	DB5	DB6	DB7

	TOLERANCE	MATERIAL	FINISH	<b>AZ DISPLAYS, INC.</b> <b>ACM1602U Series</b> TITLE FILE NAME
	VERSION	NO.	UNIT	
	DATE	APPROVED	DRAWN	
	±0.2			
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2004.04.07				