

AZ DISPLAYS, INC.

COMPLETE LCD SOLUTIONS

SPECIFICATIONS FOR LIQUID CRYSTAL DISPLAY

PART NUMBER:

AGM9624A-FN-FBW-02

DATE:

APRIL 01, 2008

General Specification

Driving IC NT7534

Interace With **Paraller** MPU 8080 Series

Display Specification

Display Dot Matrix :**96*24**

Display Mode:Positive/Transflective/FSTN Type

Viewing Angle :**6:00** Clock

Display Duty:**1/33** Driving Bias:**1/6** Driving Voltage:**7.5V**

Mechanical Characteristics(Unit:mm)

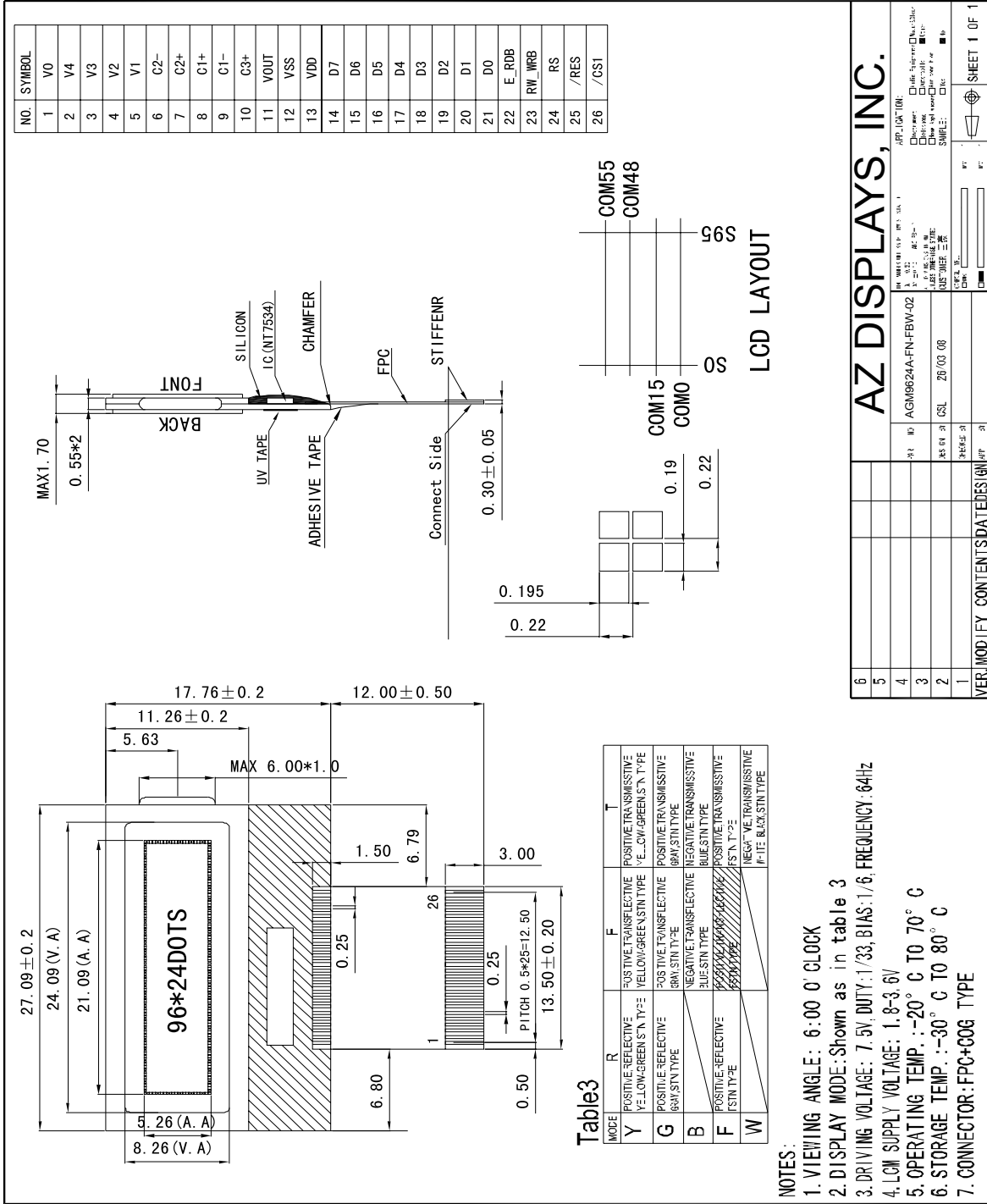
Extenal Dimension:**27.09*17.76*1.7**

View Area:**24.09*8.26**

Dots Size:**0.19*0.195**

Dots Pitch:**0.22*0.22**

External Dimension



Absolute Maximum Ratings

Item	Symbol	Standard			Unit
Power supply voltage	$V_{DD}-V_{SS}$	0	-	3.6	V
Input voltage	V_{IN}	VSS	-	VDD	
Operating temperature range	T_A	-20	-	+70	°C
Storage temperature range	T_{STO}	-30	-	+80	

*Wide temperature range is available

Interface Pin Description

Pin No	Symbol	I/O	Function
26	CS1B	I	This is the chip select signal .When CS1B= “L” and CS2= “H”,then the chip select becomes active,and data/command I/O is enabled
25	RESETB	I	When RESETB is set to “L”,the setting are initialized The RESETB operation is performed by the RESETB signal level
24	RS	I	Select register. 0:Instruction register (for write) Busy flag &address counter(for read) 1:Data register(for write and read).
23	RW-WRB	I	Read/write select signal.
22	E-RDB	I	Operation (data read/write) enable signal.
21	DB0	I/O	This is an 8-bit bi-directional data bus that connects to an 8-bit or 16-bit standard MPU data bus. When the serial interface is selected,then D7 serves as the serial data input terminal and D6 serves as the serial clock input terminal.At this time,D0-D5 are set to high impedance. When the chip select is inactive,D0 to D7 are set to high impedance.
20	DB1		
19	DB2		
18	DB3		
17	DB4		
16	DB5		
15	DB6		
14	DB7		
13	VDD	Supply	Power supply for logic
12	VSS	Supply	Ground.

11	VOUT	O	DC/DC voltage converter output																														
10	C3+	O	Capacitor3+ for internal DC/DC voltage converter																														
9	C1-	O	Capacitor1- for internal DC/DC voltage converter																														
8	C1+	O	Capacitor1+ for internal DC/DC voltage converter																														
7	C2+	O	Capacitor2+ for internal DC/DC voltage converter																														
6	C2-	O	Capacitor2- for internal DC/DC voltage converter																														
5	V1	Supply	<p>LCD driver supply voltages. The voltage determined by LCD cell is impedance-converted by a resistive driver or an operation amplifier for application. Voltages should be the following relationship:</p> $V0 > V1 > V2 > V3 > V4 > VSS$ <p>When the on-chip operating power circuit is on, the following are given to V1 to V4 by the on-chip power circuit. Voltage selection is performed by the set LCD bias command.</p> <table border="1"> <thead> <tr> <th>LCD BIAS</th> <th>V1</th> <th>V2</th> <th>V3</th> <th>V4</th> </tr> </thead> <tbody> <tr> <td>1/5 BIAS</td> <td>4/5 V0</td> <td>3/5 V0</td> <td>2/5 V0</td> <td>1/5 V0</td> </tr> <tr> <td>1/6 BIAS</td> <td>5/6 V0</td> <td>4/6 V0</td> <td>2/6 V0</td> <td>1/6 V0</td> </tr> <tr> <td>1/7 BIAS</td> <td>6/7 V0</td> <td>5/7 V0</td> <td>2/7 V0</td> <td>1/7 V0</td> </tr> <tr> <td>1/8 BIAS</td> <td>7/8 V0</td> <td>6/8 V0</td> <td>2/8 V0</td> <td>1/8 V0</td> </tr> <tr> <td>1/9 BIAS</td> <td>8/9 V0</td> <td>7/9 V0</td> <td>2/9 V0</td> <td>1/9 V0</td> </tr> </tbody> </table>	LCD BIAS	V1	V2	V3	V4	1/5 BIAS	4/5 V0	3/5 V0	2/5 V0	1/5 V0	1/6 BIAS	5/6 V0	4/6 V0	2/6 V0	1/6 V0	1/7 BIAS	6/7 V0	5/7 V0	2/7 V0	1/7 V0	1/8 BIAS	7/8 V0	6/8 V0	2/8 V0	1/8 V0	1/9 BIAS	8/9 V0	7/9 V0	2/9 V0	1/9 V0
LCD BIAS	V1			V2	V3	V4																											
1/5 BIAS	4/5 V0			3/5 V0	2/5 V0	1/5 V0																											
1/6 BIAS	5/6 V0			4/6 V0	2/6 V0	1/6 V0																											
1/7 BIAS	6/7 V0			5/7 V0	2/7 V0	1/7 V0																											
1/8 BIAS	7/8 V0			6/8 V0	2/8 V0	1/8 V0																											
1/9 BIAS	8/9 V0	7/9 V0	2/9 V0	1/9 V0																													
4	V2																																
3	V3																																
2	V4																																
1	V0																																

Electrical Characteristics

DC Characteristics

DC Characteristics (VSS = 0V, VDD = 1.8 ~ 3.6V, Ta = -40 ~ +85°C unless otherwise specified)

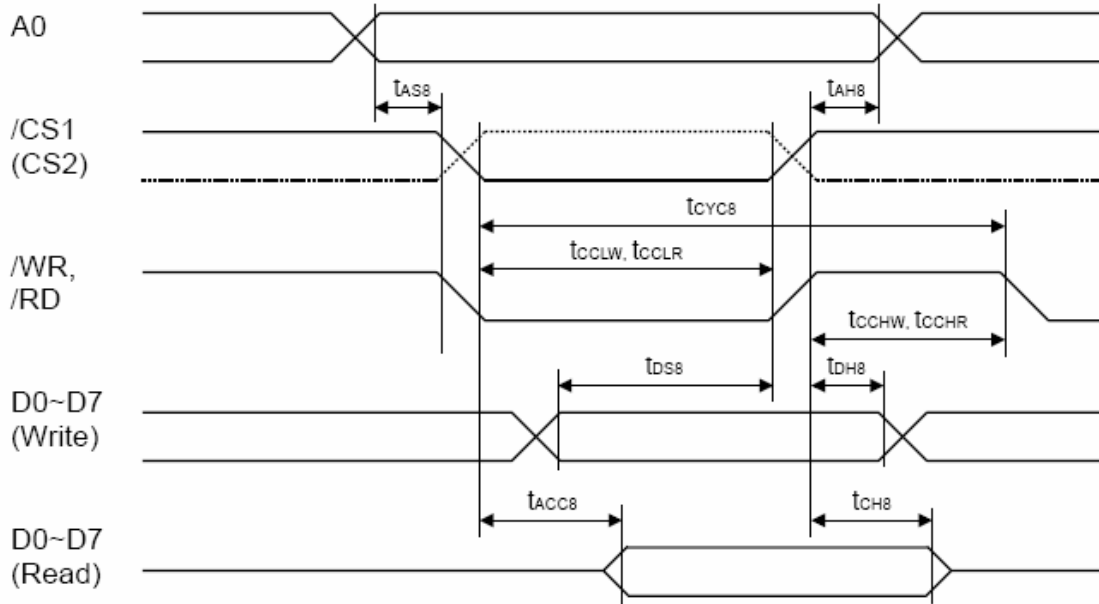
Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
VDD VDD3	Operating Voltage	1.8	-	3.6	V	
VDD2	Operating Voltage	1.8	-	3.6	V	2X, 3X boosting
		1.8	-	3.3		4X boosting
		1.8	-	2.8		5X boosting
VOUT	Booster Voltage	6.0	-	14.2	V	
V0	Voltage Regulator Operating Voltage	4.0	-	14.2	V	
VREG	Reference Voltage	2.04	2.10	2.16	V	Ta = 25°C, -0.05%/°C
IDD	Current Consumption	-	20	35	μA	VDD = 3V, V0 = 11V, built-in boosting power supply off, display on, display data = checker and no access, Ta = 25°C
		-	90	160	μA	VDD, VDD2 = 3V, V0 = 11V, 4X built-in boosting power supply, display on, display data = checker and no access, temperature gradient is -0.05%/ °C, Ta = 25°C, V0 voltage internal resistor is used, /HPM = 1 (normal power mode).
		-	150	255	μA	VDD, VDD2 = 3V, V0 = 11V, 4X built-in boosting power supply, display on, display data = checker and no access, temperature gradient is -0.05%/ °C, Ta = 25°C, V0 voltage internal resistor is used, /HPM = 0 (high power mode).

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
ISP	Sleep Mode Current Consumption	-	0.01	5	μA	During sleep, Ta = 25°C
ISB	Standby Mode Current Consumption	-	4	8	μA	During standby, Ta = 25°C
VIHC	High-Level Input Voltage	0.8 x VDD	-	VDD	V	A0, D0 - D7, /RD (E), /WR (R/W), /CS1, CS2, CLS, CL, FR, M/S, C86, P/S, /DOF, /RES, IRS and /HPM
VILC	Low-Level Input Voltage	VSS	-	0.2 x VDD	V	
VOHC	High-Level Output Voltage	0.8 x VDD	-	VDD	V	IOH = -0.5mA (D0 - D7, FR, FRS, /DOF, and CL)
VOLC	Low -Level Output Voltage	VDD	-	0.2 x VDD	V	IOL = 0.5mA (D0 - D7, FR, FRS, /DOF, and CL)
ILI	Input Leakage Current	-1.0	-	1.0	μA	Vin = VDD or VSS (A0, /RD (E), /WR (R/W), /CS1, CS2, CLS, M/S, C86, P/S, IRS and /RES)
IHZ	HZ Leakage Current	-3.0	-	3.0	μA	When the D0 - D7, FR, CL, and /DOF are in high impedance
RON1	LCD Driver ON Resistance	-	2.0	3.5	KΩ	Ta = 25°C, These are the resistance values for when a 0.1V voltage is applied between the output terminals SEGn or COMn and the various power supply terminal (V0, V1, V2, V3, V4)
RON2	LCD Driver ON Resistance	-	3.2	5.4	KΩ	
CIN	Input Pad Capacity	-	5.0	8.0	pF	Ta = 25°C, f = 1MHz
fFRM	Frame Frequency	78.0	80.5	83.0	Hz	fOSC = 31.4 KHz, 1/65duty VDD = 1.8~3.6V
		64.9	67.4	69.9	Hz	fOSC = 26.3 KHz, 1/65duty VDD = 1.8~3.6V

Notes: 1. Voltages V0 ≥ V1 ≥ V2 ≥ V3 ≥ V4 ≥ VSS2 must always be satisfied.

AC Characteristics

System Buses Read/Write Characteristics (for 8080 Series MPU)



(VDD = 2.7 ~ 3.6V, Ta = -40 ~ +85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
T_{AH8}	Address hold time	0	-	-	ns	A0
T_{AS8}	Address setup time	0	-	-	ns	
t_{CYC8}	System cycle time	240	-	-	ns	
t_{CCLW}	Control low pulse width (write)	90	-	-	ns	/WR
t_{CCLR}	Control low pulse width (read)	120	-	-	ns	/RD
t_{CCHW}	Control high pulse width (write)	100	-	-	ns	/WR
t_{CCHR}	Control high pulse width (read)	60	-	-	ns	/RD
T_{DS8}	Data setup time	40	-	-	ns	D0~D7
T_{DH8}	Data hold time	10	-	-	ns	
t_{ACC8}	/RD access time	-	-	140	ns	D0~D7, CL = 100pF
T_{CH8}	Output disable time	5	-	50	ns	

(VDD = 1.8 ~ 2.7V, Ta = -40 ~ +85°C)

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
t _{AH8}	Address hold time	0	-	-	ns	A0
t _{AS8}	Address setup time	0	-	-	ns	
t _{CYC8}	System cycle time	400	-	-	ns	
t _{CCLW}	Control low pulse width (write)	150	-	-	ns	/WR
t _{CCLR}	Control low pulse width (read)	150	-	-	ns	/RD
t _{CCHW}	Control high pulse width (write)	120	-	-	ns	/WR
t _{CCHR}	Control high pulse width (read)	120	-	-	ns	/RD
t _{DS8}	Data setup time	80	-	-	ns	D0~D7
t _{DH8}	Data hold time	30	-	-	ns	
t _{ACC8}	/RD access time	-	-	240	ns	D0~D7, CL = 100pF
t _{CH8}	Output disable time	10	-	100	ns	

*1. The input signal rise time and fall time (t_r, t_f) is specified at 15ns or less.

(t_r + t_f) < (t_{CYC8} - t_{CCLW} - t_{CCHW}) for write, (t_r + t_f) < (t_{CYC8} - t_{CCLR} - t_{CCHR}) for read.

*2. All timing is specified using 20% and 80% of VDD as the reference.

*3. t_{CCLW} and t_{CCLR} are specified as the overlap interval when /CS1 is low (CS2 is high) and /WR or /RD is low.

Command Set

Command	A0	/RD	/WR	Code										Hex	Function
				D7	D6	D5	D4	D3	D2	D1	D0				
(1) Display OFF	0	1	0	1	0	1	0	1	1	1	0	1	AEh AFh	Turn on LCD panel when high, and turn off when low	
(2) Display Start Line Set	0	1	0	0	1	Display Start Address						40h to 7Fh	Specifies RAM display line for COM0		
(3) Page Address Set	0	1	0	1	0	1	1	Page Address					B0h to B8h	Set the display data RAM page in Page Address register	
(4) Column Address Set	0	1	0	0	0	0	1	Higher Column Address				00h to 18h	Set 4 higher bits and 4 lower bits of column address of display data RAM in register		
	0	1	0	0	0	0	0	Lower Column Address							
(5) Read Status	0	0	1	Status				0	0	0	0	XX	Reads the status information		
(6) Write Display Data	1	1	0	Write Data										XX	Write data in display data RAM
(7) Read Display Data	1	0	1	Read Data										XX	Read data from display data RAM
(8) ADC Select	0	1	0	1	0	1	0	0	0	0	0	1	A0h A1h	Set the display data RAM address SEG output correspondence	
(9) Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	0	1	A6h A7h	Normal indication when low, but full indication when high	
(10) Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	0	1	A4h A5h	Select normal display (0) or entire display on	
(11) LCD Bias Set	0	1	0	1	0	1	0	0	0	1	0	1	A2h A3h	Sets LCD driving voltage bias ratio	
(12) Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	0	E0h	Increments column address counter during each write	
(13) End	0	1	0	1	1	1	0	1	1	1	0	0	EEh	Releases the Read-Modify-Write	
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	0	E2h	Resets internal functions	
(15) Common Output Mode Select	0	1	0	1	1	0	0	0	1	*	*	*	C0h to CFh	Select COM output scan direction *: invalid data	
(16) Power Control Set	0	1	0	0	0	1	0	1	Operation Status			28h to 2Fh	Select the power circuit operation mode		
(17) V0 Voltage Regulator Internal Resistor ratio Set	0	1	0	0	0	1	0	0	Resistor Ratio			20h to 27h	Select internal resistor ratio Rb/Ra mode		
(18) Electronic Volume mode Set Electronic Volume Register Set	0	1	0	1	0	0	0	0	0	0	1	81h			
	0	1	0	*	*	Electronic Control Value						XX	Sets the V0 output voltage electronic volume register		
(19) Set Static indicator ON/OFF Set Static Indicator Register	0	1	0	1	0	1	0	1	1	0	0	1	ACh ADh	Sets static indicator ON/OFF 0: OFF, 1: ON	
	0	1	0	*	*	*	*	*	*	Mode			XX	Sets the flash mode	
(20) Power Save	0	1	0	-	-	-	-	-	-	-	-	-	-	Compound command of Display OFF and Entire Display ON	
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	1	E3h	Command for non-operation	

Command	A0	/RD	/WR	Code										Function
				D7	D6	D5	D4	D3	D2	D1	D0	Hex		
(22)Oscillation Frequency Select	0	1	0	1	1	1	0	0	1	0	0	1	E4h E5h	Select the oscillation frequency
(23)Partial Display mode Set	0	1	0	1	0	0	0	0	0	1	0	1	82h 83h	Enter/Release the partial display mode
(24)Partial Display Duty Set	0	1	0	0	0	1	1	0	Duty Ratio			30h 37h	Sets the LCD duty ratio for partial display mode	
(25)Partial Display Bias Set	0	1	0	0	0	1	1	1	Bias Ratio			38h 3Fh	Sets the LCD bias ratio for partial display mode	
(26)Partial Start Line Set	0	1	0	1	1	0	1	0	0	1	1	D3h	Enter Partial Start Line Set	
Partial Start Line Set	0	1	0	1	1	Partial Start Line						XX	Sets the LCD Number of partial display start line	
(27)N-Line Inversion Set	0	1	0	1	0	0	0	0	1	0	1	85h	Enter N-Line inversion	
Number of Line Set	0	1	0	*	*	*	Number of Line					XX	Sets the number of line used for N-Line inversion	
(28)N-Line Inversion Release	0	1	0	1	0	0	0	0	1	0	0	84h	Exit N-Line Inversion	
(29)DC/DC Clock Set	0	1	0	1	1	1	0	0	1	1	0	E6h	Set DC/DC Clock Frequency	
DC/DC Clock Division Set	0	1	0	1	1	0	0	Clock Division			XX	Set the Division of DC/DC Clock Frequency		
(30)Test Command	0	1	0	1	1	1	1	*	*	*	*	F1h to FFh	IC test command. Do not use!	
(31)Test Mode Reset	0	1	0	1	1	1	1	0	0	0	0	F0h	Command of test mode reset	

Note: Do not use any other command, or system malfunction may result.

1. Display On/Off

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	1	1	1	-

D0=1 Display On

D0=0 Display Off

2. Set Display Start Line

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	1	ST5	ST4	ST3	ST2	ST1	ST0

ST5	ST4	ST3	ST2	ST1	ST0	Line address
0	0	0	0	0	0	0
0	0	0	0	0	1	1
.
1	1	1	1	1	0	62
1	1	1	1	1	1	63

3. Set Page Address

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	1	P3	P2	P1	P0

P3	P2	P1	P0	Page
0	0	0	0	0
0	0	0	1	1
.
0	1	1	1	7
1	0	0	0	8

4. Set Column Address

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	0	0	0	Y7	Y6	Y5	Y4
0	1	0	0	0	0	0	Y3	Y2	Y1	Y0

Y4-Y7 :Higter bits

Y0-Y3 :Lower bits

Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Column address
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
.
1	0	0	0	0	0	1	0	130
1	0	0	0	0	0	1	1	131

4. Read Status

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	0	1	status				0	0	0	0

5. Write Display Data

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
1	1	0	write data							

6. Read Display Data

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
1	0	1	read data							

7. ADC Select

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	0	0	0

8. Normal/Reverse Display

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	1	1	D

When D=1 Reverse Display

D=0 Normal Display

9. Entire Display On/Off

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	1	0	D

When D=0 Normal Display

D=1 Reverse Display

10. Set LCD Bias

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	0	0	1	D

When D=0 Bias=1/9

D=1 Bias=1/7

11. Read-Modify-Write

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	0	0

12. End

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	1	1	1	0

13. Reset

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	1	0	0	0	1	0

15. Command Output Mode Select

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	0	0	D	*	*	*

16. Set Power Control

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	0	1	0	1	A2	A1	A0

When A0=1 Follower Circuit Is Turn On

A1=1 Regulator Circuit Is Turn On

A2=1 Booster Circuit Is Turn On

17. V0 Voltage Regulator Internal Resistor Ratio Set

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	0	0	1	0	0	R2	R1	R0

R2	R1	R0	(1+Rb/Ra) ratio
0	0	0	3.0
0	0	1	3.5
0	1	0	4.0
0	1	1	4.5
1	0	0	5.0
1	0	1	5.5
1	1	0	6.0
1	1	1	6.4

18. The Electronic Volume Mode Set

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	0	0	0	0	0	1

19. Electronic Volume Register Set

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
----	---	----	----	----	----	----	----	----	----	----

0	1	0	0	0	SV5	SV4	SV3	SV2	SV1	SV0
---	---	---	---	---	-----	-----	-----	-----	-----	-----

SV5	SV4	SV3	SV2	SV1	SV0	Reference voltage parameter	V0	Contrast
0	0	0	0	0	0	0	Minimum	Low
0	0	0	0	0	1	1	.	.
.		
1	0	0	0	0	0	32 (Default)		
.		
1	1	1	1	1	0	62	.	.
1	1	1	1	1	1	63	Maximum	High

20.Static Indicator On/Off

RS	E	RW	D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	0	1	0	1	1	0	D

When D=0: Static Indicator Off D=1:Static Indicator On]

Application Example

1.

8951	P1.0	DB0
	P1.1	DB1
	P1.2	DB2
	P1.3	DB3
	P1.4	DB4
	P1.5	DB5
	P1.6	DB6
	P1.7	DB7
	P3.0	E
	P3.1	RW
	P3.2	RS
	P3.3	RESETB
	P3.4	CS1
		NT7534

2.

