SD0418- 72 patterns LCD driver(V1.20)

1.General description

SD0418 is a 72 patterns (18×4) ,memory mapping,and multi-function LCD driver. The S/W configuration feature of the SD0418 makes it suitable for multiple LCD applications including LCD modules and display subsystems .Only three or four lines are required for the interface between the host controller and the SD0418.The SD0418 contains a power down command to reduce power consumption.

1.1 Feature

- Operating voltage：2.4--5.2V
- Internal 256KHz RC oscillator
- 1/2 or 1/3 bias ,and selection of 1/2、1/3 or 1/4 duty LCD applications
- 18×4 LCD driver
- Built-in 18×4 bit display RAM
- 3-wire serial interface
- Internal LCD driving frequency source
- V_{LCD} pin for adjusting LCD operating voltage by change the resistor between V_{LCD} pin and V_{dd} pin
- Power down command reduces power consumption
- Data mode and command mode instructions

1.2 Pin Assignment

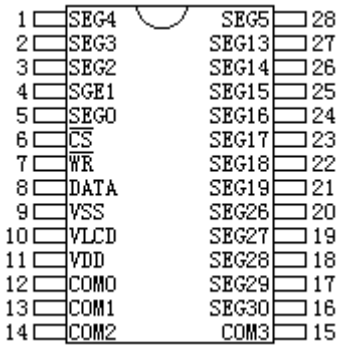


Figure 1 SD0418AP
28-PIN DIP Package

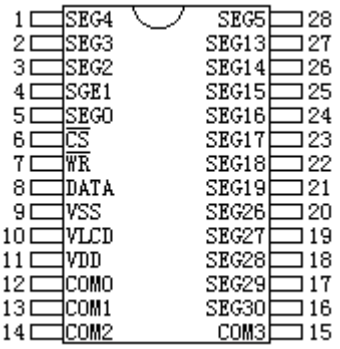


Figure 2 SD0418AS
28-PIN SOIC Package

1. 3 Pin Description

Pin No.	Pin Name	Function
1-5	SEG0-SEG5	LCD segment outputs
6	$\overline{CS}$	Chip selection input with pull-high resistor: $\overline{CS}$=1, the data and command read from and written to SD0418 are disabled;$\overline{CS}$=0, the data and command transmission between the host controller and the SD0418 are all enabled.
7	$\overline{WR}$	WRITE clock input with pull-high resistor.Data on the DATA line are latched into the SD0418 on the rising edge of $\overline{WR}$ signal.
8	DATA	Serial data input/output with pull-high resister
9	VSS	GND
10	VLCD	LCD power input
11	VDD	Positive power supply
12-15	COM0-COM3	LCD common outputs
16-28	SEG13-SEG19 SEG26-SEG30	LCD segment outputs

2.Block Diagram

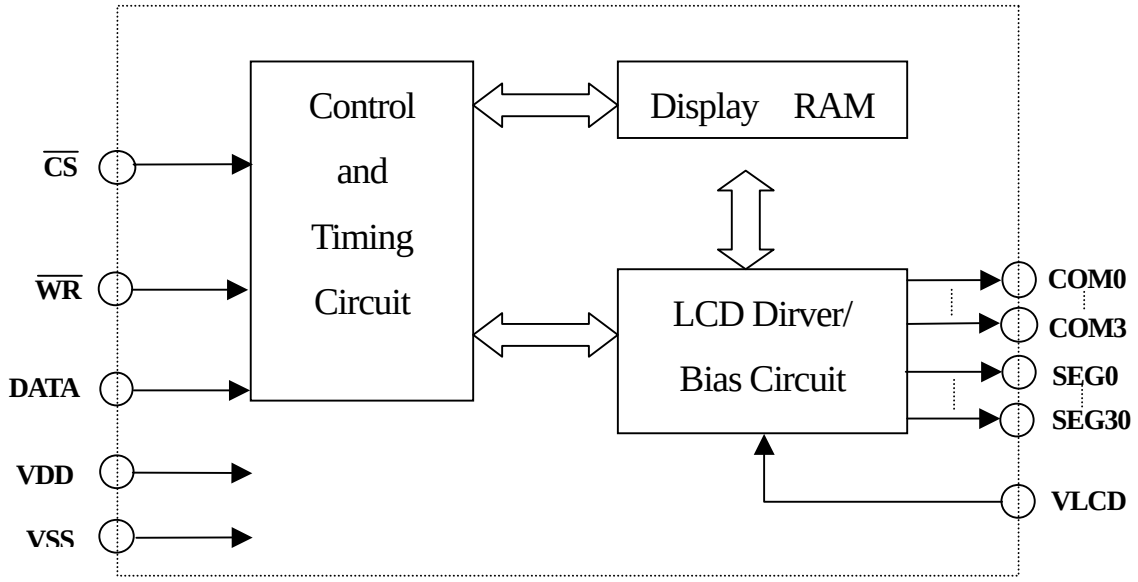


Figure3 Block diagram

3、Functional Description

3. 1 Display memory RAM

The static display memory (RAM) is organized into 18×4bits and stores the displayed data。The contents of the RAM are directly mapped to the contents of LCD driver.Data in the RAM can be accessed by the WRITE command.The following is a mapping from the RAM to the LCD pattern:

SEG / COM	COM3	COM2	COM1	COM0	Address 6 bits (A5, A4…A0)
SEG0					0
SEG1					1
SEG2					2
SEG3					3
SEG4					4
SEG5					5
SEG13					13
SEG14					14
SEG15					15
SEG16					16
SEG17					17
SEG18					18
SEG19					19
SEG26					26
SEG27					27
SEG28					28
SEG29					29
SEG30	D3	D2	D1	D0	30
Data 4 bits (D3,D2,D1,D0)	BIT3	BIT2	BIT1	BIT0	DATA / ADDR

3. 2 System oscillator

The SD0418 system clock(on-chip RC oscillator) is used to generate the time base,LCD driving clock.After the SYS DIS command is executed ,the system clock will stop and the LCD bias generator will turn off.Once the system clock stops,the LCD display will become blank。

The LCD OFF command is used to turn the LCD bias generator off.After the LCD bias generator switches off by issuing the LCD OFF command,using SYS DIS command reduces power consumption.At the initial system power on,the SD0418 is at the SYS DIS state。

3. 3 LCD driver

SD0418 is a 72(18×4)pattern LCD driver.It can be configured as 1/2 or 1/3 bias and 2 or 3 or 4 commonds of LCD driver by the S/W configuration.This feature makes the SD0418 suitable for multiply LCD applications。The LCD corresponding commands are summarized in the following table：

Name	Command Code	Function
LCD OFF	**100**00000010X	Turn off LCD bias generator
LCD ON	**100**00000011X	Turn on LCD bias generator
BIAS & COM	**100**0010abXcX	c=0:1/2 bias option c=1:1/3 bias option ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option

The bold form of 100,namely **100**,indicates the command mode ID。If successive commands have been issued, the Command mode ID except for the first command, will be omitted.The LCD OFF command turns the LCD display off by disabling the LCD bias generator.The LCD ON command,on the other hand, turns the LCD display on by enabling the bias generator.Using the LCD related commands ,the SD0418 can be compatible with most types of LCD panels。(X:Don't care)

3. 4 Command format

SD0418 can be configured by the S/W setting.There are two mode commands to configure the SD0418 resources and to transfer the LCD display data.The command mode consists of a system configuration command,a LCD configuration command and an operating command.The data mode,on the other hand,includes WRITE operation.The following are the data mode ID and the command mode ID。

Operation	Mode	ID
WRITE	Data	**101**
COMMAND	Command	**100**

The mode command should be issued before the data or command is transferred.If successive commands have been issued,the command mode ID,namely **100**,can be omitted. While the system is operating in the non-successive command or the non-successive address data mode, the $\overline{CS}$ pin should be set to "1" and the previous operation mode will be reset also.Once the $\overline{CS}$ pin return to "0",a new operation mode ID should be issued first。

3. 5 Interfacing

Only three lines are required to interface with the SD0418：the $\overline{CS}$ line is used to initialize the serial interface circuit and to terminate the communication between the host controller and the SD0418.If the $\overline{CS}$ pin is set to 1,the data and command issued between the host controller and the SD0418 are first disable, and then initialized.Data to be written or commands to be written have to be passed through the DATA line.The $\overline{WR}$ line is the WRITE clock input.The data ,address,and command on the DATA lines are all clocked into the SD0418 on rising edge of the $\overline{WR}$ signal。

3.6 Application Circuits

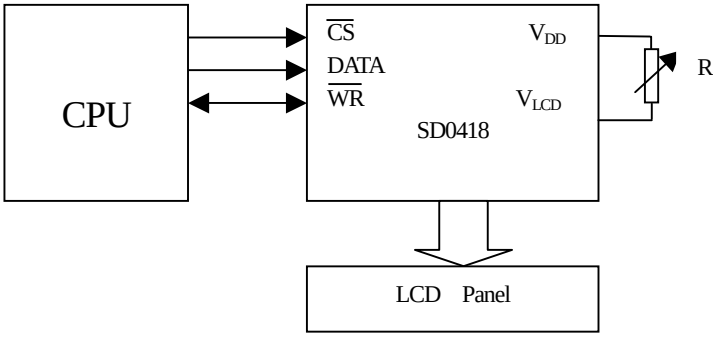


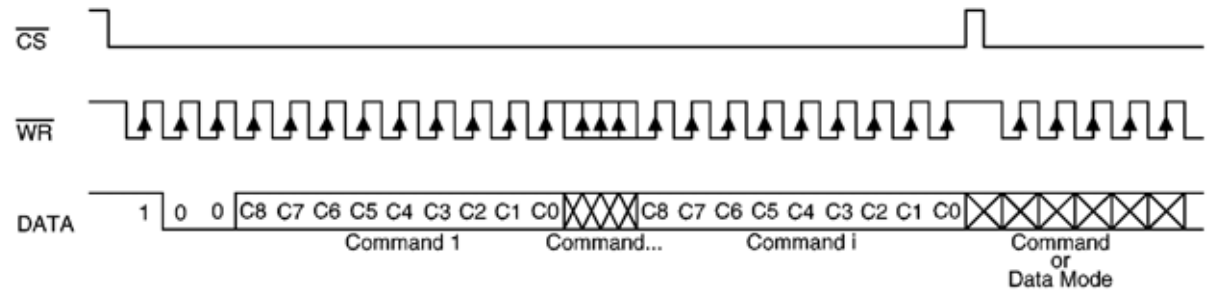
Figure 4 Application circuits

Notes：

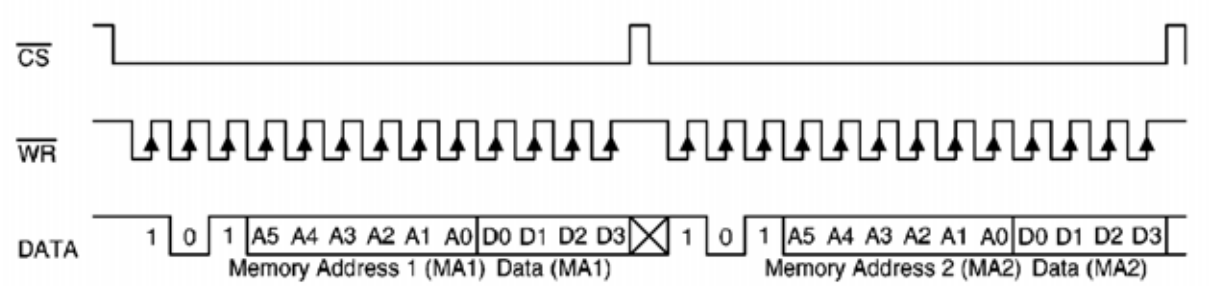
1. $V_{LCD} < V_{DD}$
2. Adjust R to fit LCD display。At V_{DD} =5V, V_{LCD} =4V, R=15KΩ±20%。

3.7 Timing diagrams

Coommand mode (command code：100)



WRITE mode (command code:101)



WRITE mode (successive address writing)

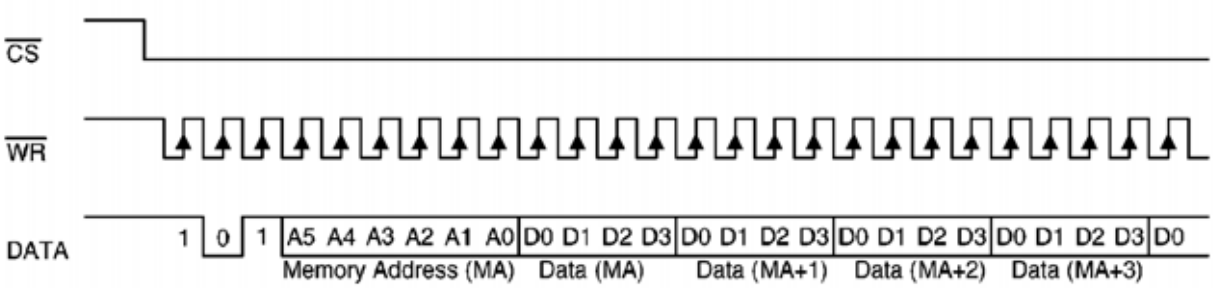


Figure5 Timing diagrams

3. 8 Command Summary

Name	Command Code	D/C	Function	Def.
WRITE	**101** a5 a4 a3 a2 a1 a0 d0 d1 d2 d3	D	Write data to the RAM	
SYS DIS	**100**00000000X	C	Turn off both system oscillator and LCD bias generator	√
SYS EN	**100**00000001X	C	Turn on system oscillator	
LCD OFF	**100**00000010X	C	Turn off LCD bias generator	√
LCD ON	**100**00000011X	C	Turn on LCD bias generator	
BIAS 1/2	**100**0010abX0X	C	LCD 1/2 bias option： ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option	
BIAS 1/3	**100**0010abX1X	C	LCD 1/3 bias option： ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option	
TOPT	**100**11100000X	C	Test mode	
TNORMAL	**100**11100011X	C	Normal mode	√

Notes：D/C：D：Data mode C：Command mode
X：Don’t care

4、Electrical Specifications

4.1 Absolute Maximum Rating

- Supply Voltage：-0.3V--5.5V
- Storage Temperature：-50°C-125°C
- Input Voltage：VSS-0.34V-VDD+0.3V
- Operating Temperature：-25°C-75°C

4.2 DC Characteristics

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		Vdd	Conditions				
V_{DD}	Operating Voltage	-	-	2.4	-	5.2	V
I_{DD}	Operating Current	3V	No load/ LCD ON	-	150	300	μA
		5V		-	300	600	μA
I_{STB}	Standby Current	3V	No load/ Power down mode	-	0.1	5	μA
		5V		-	0.3	10	μA
V_{IL}	Input Low Voltage	3V	DATA,$\overline{WR}$,$\overline{CS}$	0	-	0.6	V
		5V		0	-	1.0	
V_{IH}	Input High Voltage	3V	DATA,$\overline{WR}$,$\overline{CS}$	2.4	-	3.0	V
		5V		4.0	-	5.0	
I_{OL1}	DATA	3V	VOL=0.3V	0.5	1.2	-	mA
		5V	VOL=0.5V	1.3	2.6	-	
I_{LH1}	DATA	3V	VOH=2.7V	-0.4	-0.8	-	mA
		5V	VOH=4.5V	-0.9	-1.8	-	
I_{OL2}	LCD Common Sink Current	3V	VOL=0.3V	80	150	-	μA
		5V	VOL=0.5V	150	250	-	
I_{OH2}	LCD Common Source Current	3V	VOH=2.7V	-80	-120	-	μA
		5V	VOH=4.5V	-120	-200	-	
I_{OL3}	LCD Segment Sink Current	3V	VOL=0.3V	60	120	-	μA
		5V	VOL=0.5V	120	200	-	
I_{OH3}	LCD Segment Source Current	3V	VOH=2.7V	-40	-70	-	μA
		5V	VOH=4.5V	-70	-100	-	
R_{PH}	Pull-high Resistor	3V	DATA,$\overline{WR}$,$\overline{CS}$	40	80	150	KΩ
		5V		30	60	100	

4.3 AC Characteristics

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Unit
		Vdd	Conditions				
F_{SYS}	System Clock	3V	On-chip RC oscillator	---	256		KHz
		5V		---	256		KHz
F_{LCD}	LCD Clock	-	On-chip RC oscillator	---	$F_{SYS}/1024$		Hz
T_{COM}	LCD Common Period	-	N：Number of COM	---	N/f_{LCD}		s
F_{CLK}	Serial Data Clock ($\overline{WR}$ pin)	3V	Duty cycle 50%	---	-	150	KHz
		5V		---	-	300	KHz
T_{CS}	Serial Interface Reset Pulse Width	-	$\overline{CS}$	---	250	-	ns
t_{CLK}	$\overline{WR}$ Input Pulse Width (Figure 6)	3V	Write mode	3.34	-	-	μs
		5V	Write mode	1.67	-	-	μs
t_R, t_F	Rise/Fall Time Serial Data Clock Width (Figure 6)	3V	--	---	120	-	ns
		5V					
t_{SU}	Setup Time for DATA To $\overline{WR}$ Clock Width (Figure 7)	3V	--	---	120	-	ns
		5V					
t_H	Hold Time for DATA To $\overline{WR}$ Clock Width (Figure 7)	3V	--	---	120	-	ns
		5V					
t_{su1}	Setup Time for $\overline{CS}$ To $\overline{WR}$ Clock width (Figure 8)	3V	--	---	120	-	ns
		5V					
t_{h1}	Hold Time for $\overline{CS}$ to $\overline{WR}$ Clock Width (Figure 8)	3V	--	---	120	-	ns
		5V					

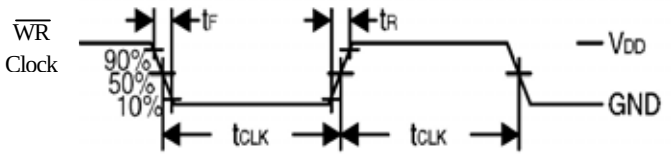


Figure 6

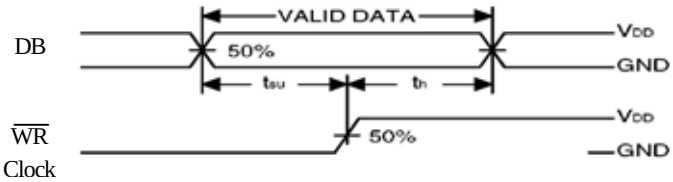


Figure 7

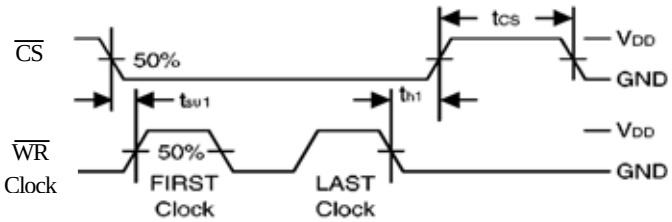


Figure 8

5. Packages and Dimensions：

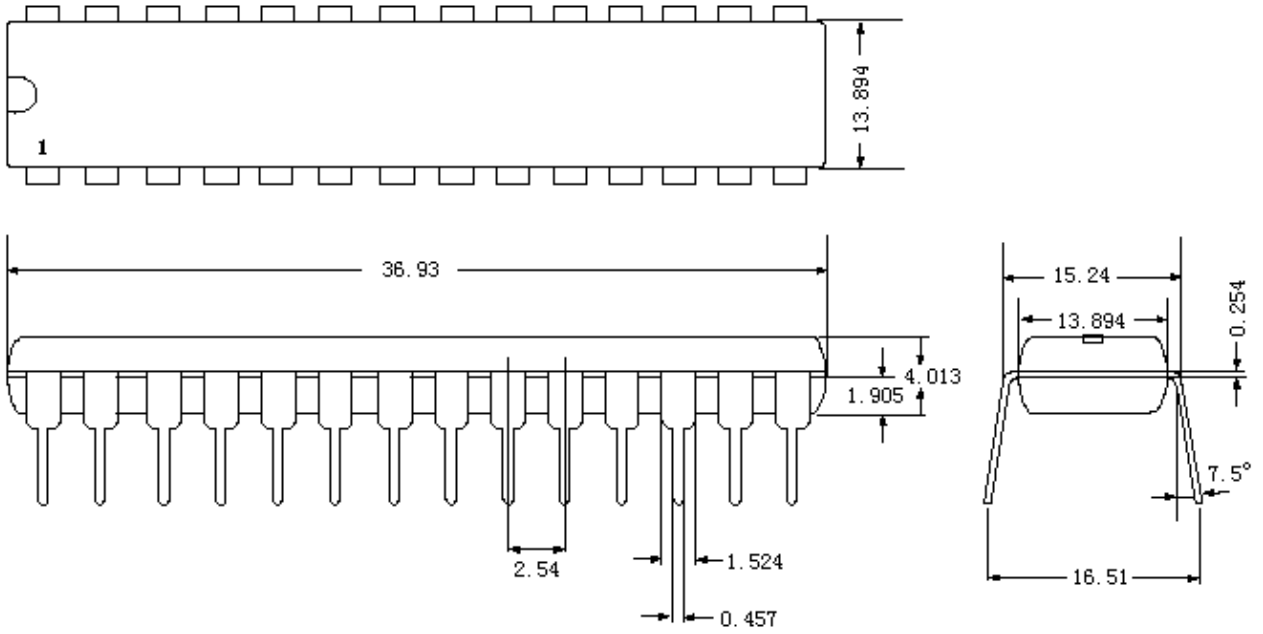


Figure 9 SD0418AP 28-PIN DIP

Unit:mm.

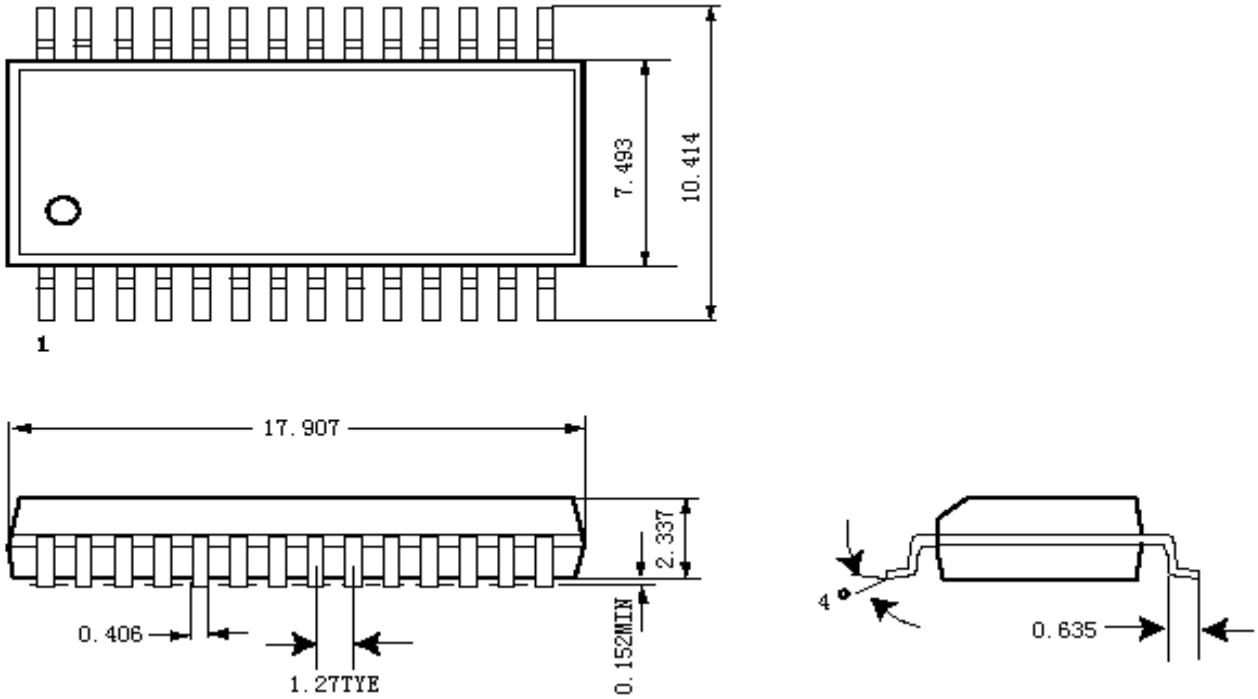


Figure 10 SD0418AS 28-PIN SOIC

Unit:mm