

SL1904 Data sheet description Ver2.8

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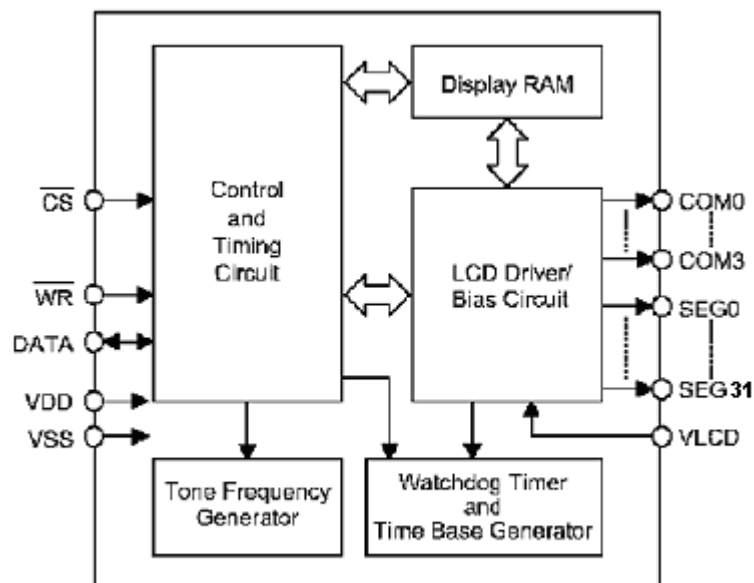
● Features

- Operating voltage : 2.4V~5.2V
- Built-in 256KHz RC oscillator
- Selection of 1/2 or 1/3 bias, and selection of 1/2 or 1/3 or 1/4 duty LCD applications
- Internal time base frequency sources
- Power down command reduces power consumption
- 19x4 LCD driver
- Built-in 19x4 bit display RAM
- Internal LCD driving frequency source
- Software configuration feature
- Data mode and command mode instructions
- Write address auto increment
- Three data accessing modes
- VLCD pin for adjusting LCD operating voltage

● General Description

The SL1904 is a 76 patterns (19x4), memory mapping, and multi-function LCD driver. The S/W configuration feature of the SL1904 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 SL1904. The SL1904 contains a power down command to reduce power consumption.

Block Diagram



Note: CSB: Chip selection
 WRB, DATA: Serial interface
 COM0~COM3, SEG0~SEG31: LCD outputs

● Pad Description

Pad No.	Pad Name	I/O	Function
2	CSB	I	Chip selection input with pull high resistor When the CS is logic high, the data and command read from or written to the SL1904 are disabled. The serial interface circuit is also reset. But if CS is at logic low level and is input to the CS pad, the data and command transmission between the host controller and the SL1904 are all enabled.
3	DATA	I/O	Serial data input/output with pull high resistor
4	WRB	I	WRITE clock input with pull high resistor Data on the DATA line are latched into the SL1904 on the rising edge of the WR signal.
5	VSS	-	Negative power supply, ground
6	VLCD	I	LCD power input
7	VDD	-	Positive power supply
8~11	COM0~COM3	O	LCD common outputs
12~29 1	SEG31~SEG0	O	LCD segment outputs

● Absolute Maximum Ratings

Supply Voltage	.....	- 0.3V	~	5.5V
Storage Temperature	.....	- 50℃	~	125℃
Input Voltage	.....	VSS - 0.3V	~	VDD + 0.3V
Operating Temperature	.....	- 25℃	~	75℃

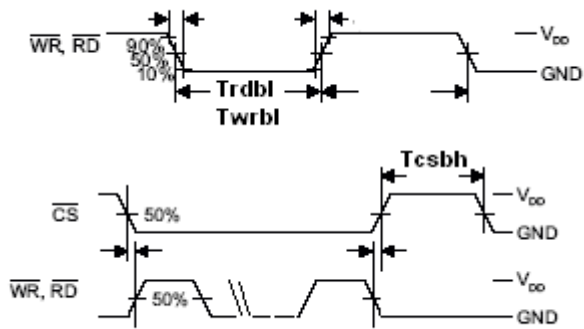
Note: These are stress ratings only. Stresses exceeding the range specified under _Absolute Maximum Ratings_ may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability

- DC Characteristic

D.C. Characteristics

Symbol	Parameter	Test Conditions		Min	Typ.	Max	Unit.
		VDD	Conditions				
Vdd	Operating voltage			2.4	5	5.2	V
Idd1	Operating current	5V	No load /LCD ON On-chip RC oscillator (256K Hz)		150	500	μ A
Idd2	Operating current	5V	No load /LCD ON Crystal oscillator (32.768 K Hz)		120	200	μ A
Idd3	Operating current	5V	No load /LCD ON External Clock source (256K Hz)		180	350	μ A
Istb	Standby Current	5V	No load Power down mode		2	10	μ A
Io1	DATA	5V	VOL=2.5V	20	30		mA
Io2	DATA	5V	VOH=3.2V	10	15		mA
Io3	LCD Common Sink Current	5V	VOL=2.5V	2.1	2.5		mA
Io4	LCD Common Source Current	5V	VOH=2.5V	1.3	1.5		mA
Io5	LCD Segment Sink Current	5V	VOL=2.5V	1.2	1.5		mA
Io6	LCD Segment Source Current	5V	VOH=2.5V	0.7	1		mA

- AC Character



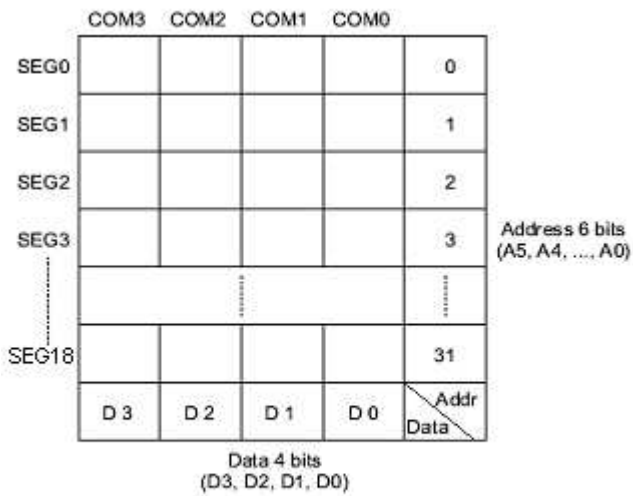
Symbol	Parameter	Vdd	Min	Typ.	Max	Unit.
F _{int3}	Internal RC oscillator	3V		151		KHz
F _{int5}	Internal RC oscillator	5V		266		KHz
T _{wrbl3}	Minimum write low pulse	3V	450			ns
T _{wrbl5}	Minimum write low pulse	5V	350			ns
T _{csbh5}	Minimum CSB high pulse	5V	55			ns

● **Functional Description**

■ **Memory Mapping**

The static display RAM is organized into 19x4 bits and stores the display data. The contents of the RAM are directly mapped to the contents of the LCD driver. Data in the RAM can be accessed by the WRITE commands.

The following is a mapping from the RAM to the LCD patterns.



RAM mapping

The memory mapping table is as following.

DISPLAY SEG	SEG0	SEG1	SEG2	SEG3	SEG4	SEG5	SEG6
MEMORY ADDRESS	0	2	4	6	8	10	12
DISPLAY SEG	SEG7	SEG8	SEG9	SEG10	SEG11	SEG12	SEG13
MEMORY ADDRESS	14	15	16	18	20	22	24
DISPLAY SEG	SEG14	SEG15	SEG16	SEG17	SEG18		
MEMORY ADDRESS	26	28	29	30	31		

System Oscillator

The SL1904 system clock is used to generate the time base, LCD driving clock. The source of the clock is from an on chip RC oscillator (256 KHz). The configuration of the system oscillator is as shown. After the SYS DIS command is executed, the system clock will stop and the LCD bias generator will turn off. That command is, however, available only for the on chip RC oscillator. 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 the SYS DIS command reduces power consumption, serving as a system power down command. But if the external clock source is chosen as the system clock, using the SYS DIS command can neither turn the oscillator off nor carry out the power down mode. At the initial system power on, the SL1904 is at the SYS DIS state.

LCD Driver

The SL1904 is a 128 (19x4) pattern LCD driver. It can be configured as 1/2 or 1/3 bias and 2 or 3 or 4 commons of LCD driver by the S/W configuration. This feature makes the SL1904 suitable for multiply LCD applications.

The LCD driving clock is derived from the system clock. The value of the driving clock is always 256Hz, an on chip RC oscillator frequency, or an external frequency. The LCD corresponding commands are summarized in the table. The bold form of 1 0 0, namely **1 0 0**, 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 LCD bias generator. The BIAS and COM are the LCD panel related commands. Using the LCD related commands; the SL1904 can be compatible with most types of LCD panels.

Command Format

The SL1904 can be configured by the S/W setting. There are two mode commands to configure the SL1904 resources and to transfer the LCD display data. The configuration mode of the SL1904 is called command mode, and its command mode ID is **1 0 0**. The command mode consists of a system configuration command, a system frequency selection command, a LCD configuration command, and an operating command. The following are the data mode IDs and the command mode ID:

Operation	Mode	ID
READ	Data	1 1 0
WRITE	Data	1 0 1
READ-MODIFY-WRITE	Data	1 0 1
COMMAND	Command	1 0 0

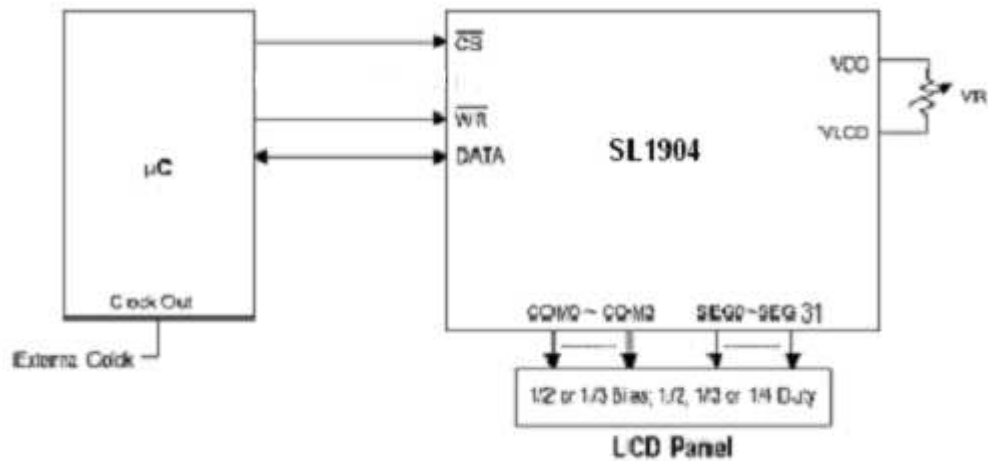
The mode command should be issued before the data or command is transferred. If successive commands

have been issued, the command mode ID, namely 1 0 0, can be omitted. While the system is operating in the non-successive command or the non-successive address data mode, the CS pin should be set to "1" and the previous operation mode will be reset also. Once the CS pin returns to "0" a new operation mode ID should be issued first.

● Interfacing

Only four lines are required to interface with the SL1904. The CS line is used to initialize the serial interface circuit and to terminate the communication between the host controller and the SL1904. If the CS pin is set to "1", the data and command issued between the host controller and the SL1904 are first disabled and then initialized. Before issuing a mode command or mode switching, a high level pulse is required to initialize the serial interface of the SL1904. The DATA line is the serial data input/output line. Data to be written or commands to be written have to be passed through the DATA line. The WR line is the WRITE clock input. The data, address, and command on the DATA line are all clocked into the SL1904 on the rising edge of the WR signal.

- **Application Circuit**



Host controller with a SL1904 display system

Note: The voltage applied to V_{LCD} pin must be lower than V_{DD} .

Adjust VR to fit LCD display, at $V_{DD} = 5V$, $V_{LCD} = 4V$, $VR = 15K\Omega$

Adjust R to fit user's time base clock.

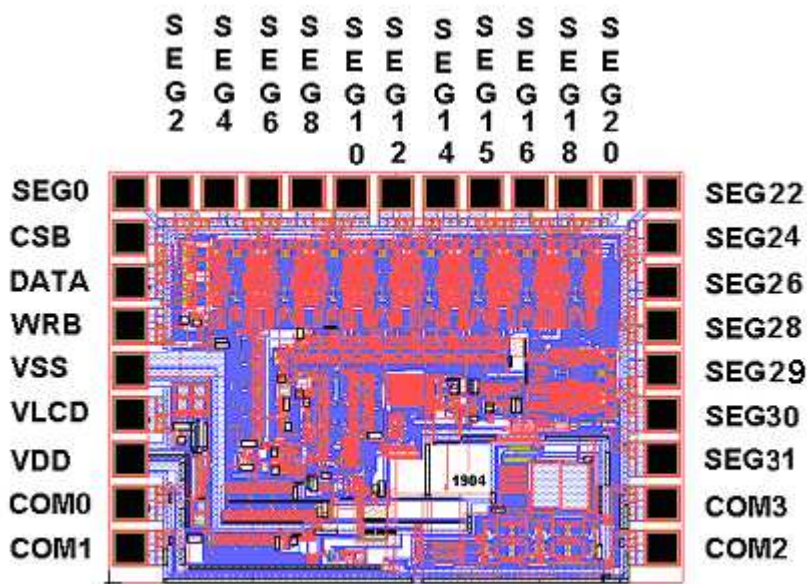
● Command Index

Name	ID	Command Code	D/C	Function	Def.
WRITE	1 0 1	A5A4A3A2A1A0D0D1D2D3	D	Write data to the RAM	
LCD OFF	1 0 0	0000-0010-X	C	Turn off LCD bias generator	Yes
LCD ON	1 0 0	0000-0011-X	C	Turn on LCD bias generator	
SYS DIS	1 0 0	0000-0000-X	C	Turn off both system oscillator and LCD bias generator	Yes
SYS EN	1 0 0	0000-0001-X	C	Turn on system oscillator	
BIAS 1/2	1 0 0	0010-abX0-X	C	LCD 1/2 bias option ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option	
BIAS 1/3	1 0 0	0010-abX1-X	C	LCD 1/3 bias option ab=00: 2 commons option ab=01: 3 commons option ab=10: 4 commons option	

Note: X: Don't care
A5~A0: RAM addresses
D3~D0: RAM data
D/C: Data/command mode
Def.: Power on reset default

All the bold forms, namely 1 1 0, 1 0 1, and 1 0 0, are mode commands. Of these 1 0 0 indicates the command mode ID. If successive commands have been issued, the command mode ID except for the first command will be omitted. It is recommended that the host controller should initialize the SL1904 after power on reset, for power on reset may fail, which in turn leads to the malfunctioning of the SL1904.

● Pin Assignment



The IC substrate should be connected to VDD in the PCB layout artwork.

● Pad Coordinates

No.	Pin Name	X	Y	No.	Pin Name	X	Y
1	SEG0	60	1124.8	19	SEG26	1596	868.8
2	CSB	60	996.8	20	SEG24	1596	996.8
3	DATA	60	868.8	21	SEG22	1596	1124.8
4	WRB	60	740.8	22	SEG20	1468	1124.8
5	VSS	60	612.8	23	SEG18	1340	1124.8
6	VLCD	60	484.8	24	SEG16	1212	1124.8
7	VDD	60	356.8	25	SEG15	1084	1124.8
8	COM0	60	228.8	26	SEG14	956	1124.8
9	COM1	60	100.8	27	SEG12	828	1124.8
10	COM2	1596	100.8	28	SEG10	700	1124.8
11	COM3	1596	228.8	29	SEG8	572	1124.8
12	SEG31	1596	356.8	30	SEG6	444	1124.8
13	SEG30	1596	484.8	31	SEG4	316	1124.8
14	SEG29	1596	612.8	32	SEG2	188	1124.8
18	SEG28	1596	772.8		LOGO	960	272

● History

Date	Name	Version	Comment
2003/2/10	CC Kuo	1.0	Initial
2003/2/13	CC Kuo	1.1	
2003/2/26	CC Kuo	1.2	
2003/9/05	CC Kuo	2.0	
2003/9/20	CC Kuo	2.1	Add AC timing spec.
2003/10/22	CC Kuo	2.2	
2003/10/31	CC Kuo	2.3	
2004/2/24	CC Kuo	2.4	Modify the AC spec.
2004/4/23	CC Kuo	2.5	Modify the memory mapping
2005/5/10	Lisa	2.6	Modify the Operating voltage
2005/6/8	Lisa	2.7	Modify the command code
2005/6/17	Lisa	2.8	Modify the Operating voltage