



VFD CONTROLLER / DRIVER

GENERAL DESCRIPTION

SM6311 is a Vacuum Fluorescent Display (VFD) Controller driven on a 1/8 to 1/16 duty factor. Twelve segment output lines, 8 grid output lines, 8 segment/grid output drive lines, key scan, one display memory, IC control circuit are all incorporated in a single chip. This SM6311 is ideal as a peripheral device of a single chip microcomputer.

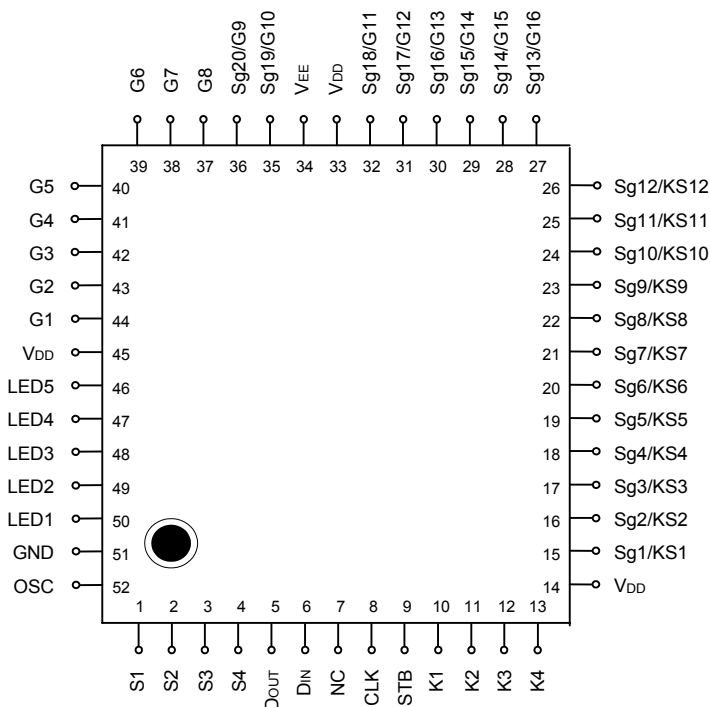
FEATURES

- * Multiple Display Modes
- * High Voltage Output
- * Key Scanning
- * General Purpose Input Ports (4 bit)
- * Dimming Circuitry (8 segment)
- * LED Display Ports(5 outs, 20mA max)
- * No external Resistors Needed for Driver Outputs
- * Serial Interface for controller

APPLICATIONS

- * Audio System
- * Car Stereo
- * VCD
- * DVD
- * VCR
- * TV

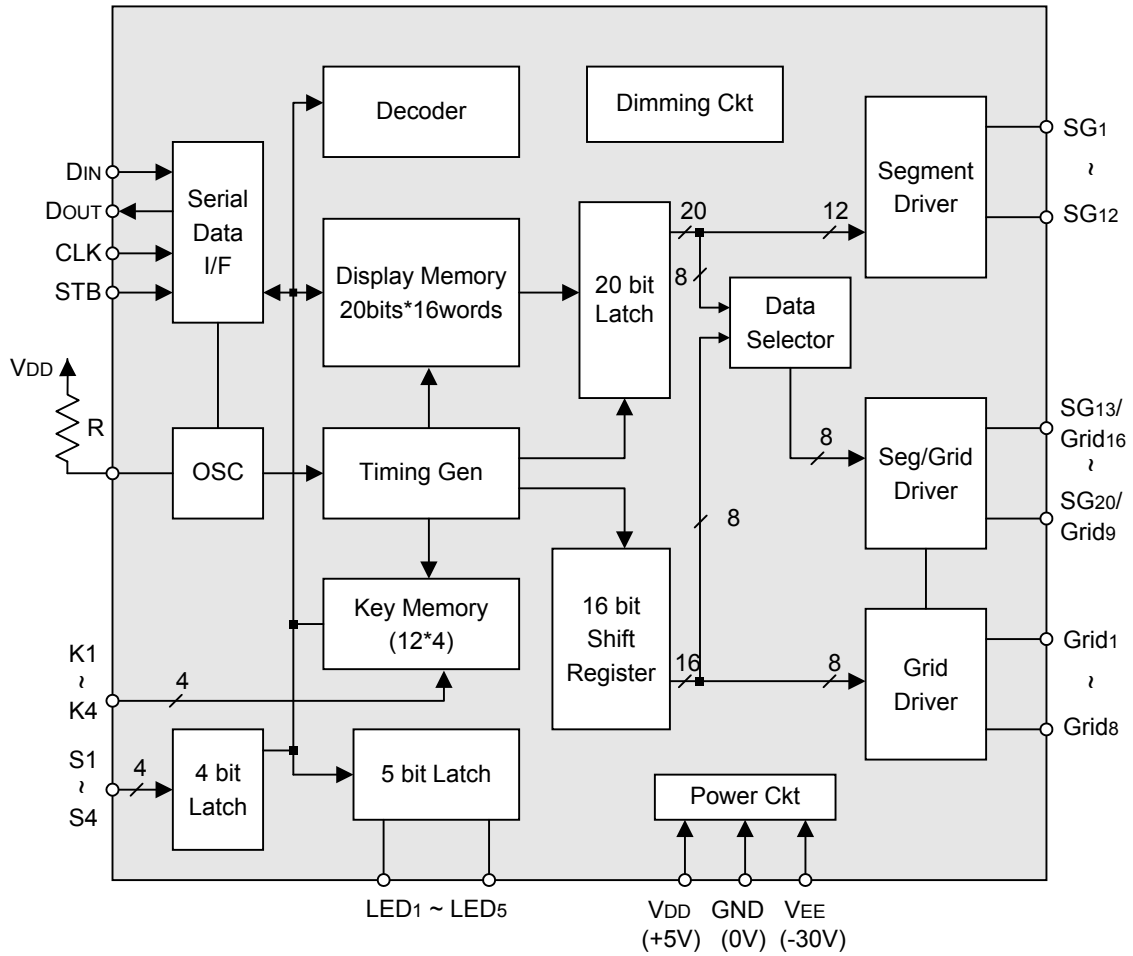
PIN DIAGRAM (TOP VIEW)





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BLOCK DIAGRAM



**VFD CONTROLLER / DRIVER****PIN DESCRIPTION**

SYMBOL	PIN NAME	PIN NO.	FUNCTION DESCRIPTION
S1 to S4	Switch Input	1 to 4	4 bit general-purpose input port.
DOUT	Data Output	5	Outputs serial data at falling edge of shift clock, starting from lower bit.
DIN	Data Input	6	Input serial data at rising edge of shift clock, starting from lower bit.
GND	Logic Ground	7,51	Connect this pin to GND of system.
CLK	Clock Input	8	Reads serial data at rising edge, and outputs data at falling edge.
STB	Strobe	9	While STB is low, Data is valid; while STB is high, CLK is ignored.
K1 to K4	Key data input	10 to 13	Data input to these pins is latched at end of display cycle.
VDD	Logic Power	14, 33, 45	5V±10%.
Sg1/KS1~ Sg12/KS12	Segment/Key	15 to 26	Segment output pins (Dual function as key source).
Sg12/G16~ Sg20/G9	Segment/Grid	27 to 32 35 to 36	These pins are selectable for segment or grid output.
VEE	Pull Down Level	34	VDD-35V max.
G1~G8	Grid	37 to 44	Grid output pins
LED1~LED5	LED Output	46 to 50	CMOS output. +20 mA max.
OSC	Oscillator Pin	52	Connect resistor for determining oscillation frequency to this pin.

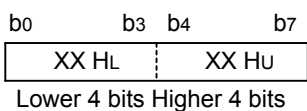


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Display RAM Address and Display Mode

The display RAM stores the data transmitted from an external device to the SM6311 through the serial interface, and is assigned addresses as follows, in units of 8 bits :

Seg1	Seg4	Seg8	Seg12	Seg16	Seg20	
00 HL	00 Hu	01 HL	01 Hu	02 HL		DIG1
03 HL	03 Hu	04 HL	04 Hu	05 HL		DIG2
06 HL	06 Hu	07 HL	07 Hu	08 HL		DIG3
09 HL	09 Hu	0A HL	0A Hu	0B HL		DIG4
0C HL	0C Hu	0D HL	0D Hu	0E HL		DIG5
0F HL	0F Hu	10 HL	10 Hu	11 HL		DIG6
12 HL	12 Hu	13 HL	13 Hu	14 HL		DIG7
15 HL	15 Hu	16 HL	16 Hu	17 HL		DIG8
18 HL	18 Hu	19 HL	19 Hu	1A HL		DIG9
1B HL	1B Hu	1C HL	1C Hu	1D HL		DIG10
1E HL	1E Hu	1F HL	1F Hu	20 HL		DIG11
21 HL	21 Hu	22 HL	22 Hu	23 HL		DIG12
24 HL	24 Hu	25 HL	25 Hu	26 HL		DIG13
27 HL	27 Hu	28 HL	28 Hu	29 HL		DIG14
2A HL	2A Hu	2B HL	2B Hu	2C HL		DIG15
2D HL	2D Hu	2E HL	2E Hu	2F HL		DIG16



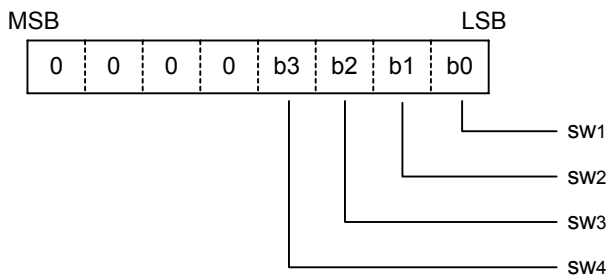
Only the lower 4 bits of the addresses assigned to Seg17 through Seg20 are valid, and the higher 4 bits are ignored.



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SW DATA

The SW data is read by a read command, starting from the least significant bit. Bits 5 through 8 of the SW data are 0.



COMMAND

A command sets the display mode and status of the FIP driver. The first 1 byte input to the SM6311 through the DIN pin after the STB pin has fallen is regarded as a command.

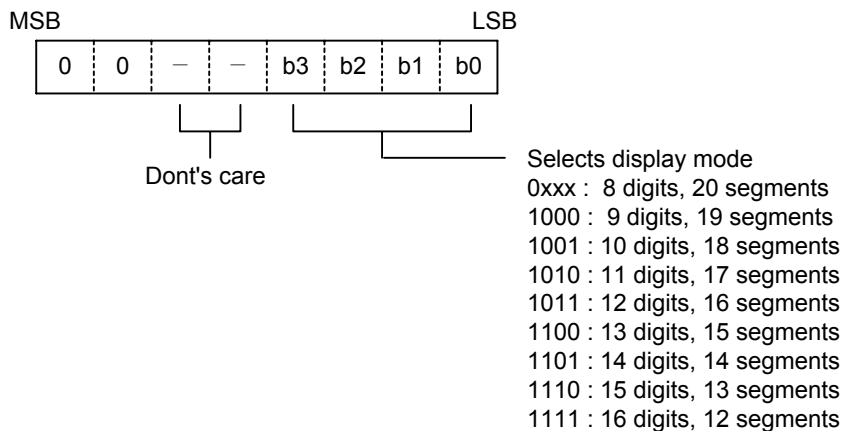
If STB is made high while a command / data is transmitted, serial communication is initialized, and the command / data being transmitted is invalid (however, the command / data already transmitted remains valid).

(1) Display mode setting command

The command initializes the SM6311 and selects the number of segments and number of grids (1/8 to 1/16 duty, 12 segments to 20 segments).

When this command is executed, display is forcibly tuned off, and key scanning is also stopped.

To resume display, a display ON command must be executed. If the same mode is selected, however, nothing is performed.

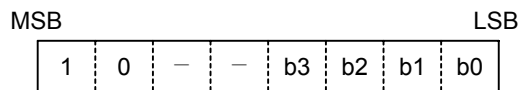


On power application, the 16-digit, 12-segment mode is selected.



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DISPLAY CONTROL COMMAND



Dont's care

Sets dimming quantity

- 000 : Sets pulse width to 1/16
- 001 : Sets pulse width to 2/16
- 010 : Sets pulse width to 4/16
- 011 : Sets pulse width to 10/16
- 100 : Sets pulse width to 11/16
- 101 : Sets pulse width to 12/16
- 110 : Sets pulse width to 13/16
- 111 : Sets pulse width to 14/16

Turns on / off display.

- 0 : Display off (key scan contiunes *)
- 1 : Display on

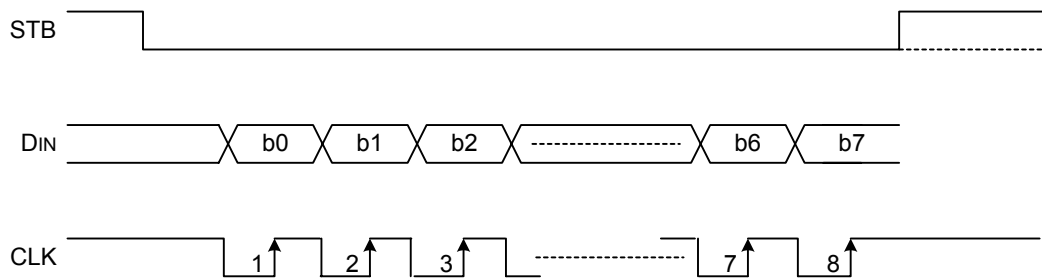
*: On power application, key scanning is stopped.



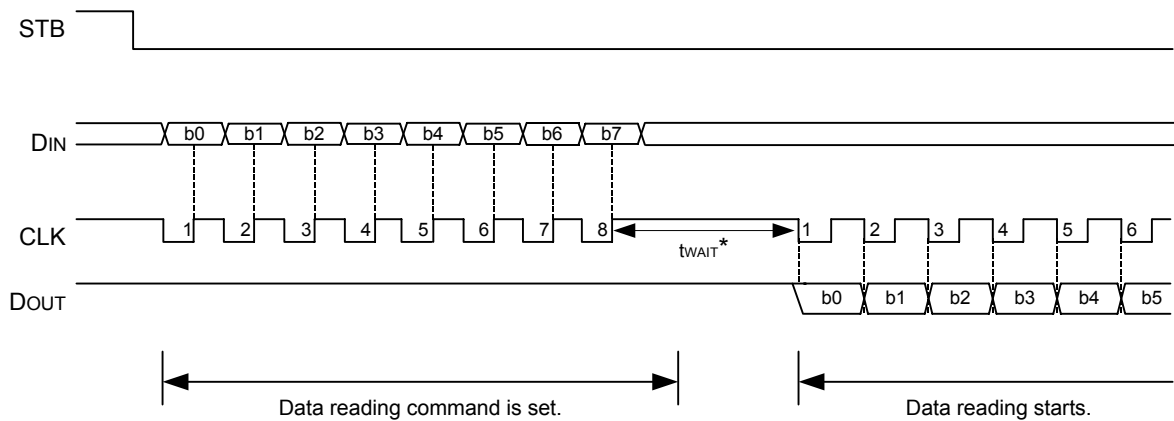
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SERIAL COMMUNICATION FORMAT

Reception (command / data write)



Transmission (data read)



Because the DOUT pin is an N-ch, open-drain output pin, be sure to connect an external pull-up resistor to this pin (1 K Ω to 10 K Ω).

* : When data is read, a wait time tWAIT of 1 μ s is necessary since the rising of the eighth clock that has set the command, until the falling of the first clock that has read the data.

**VFD CONTROLLER / DRIVER****ABSOLUTE MAXIMUM RATINGS**

(Ta=25°C, GND=0V)

PARAMETER	SYMBOL	RATING	UNIT
Logic Supply Voltage	VDD	-0.5 to +7	V
Driver Supply Voltage	VEE	VDD+0.5 to VDD-30	V
Logic Input Voltage	VI	-0.5 to VDD+0.5	V
VFD Driver Output Voltage	VO	VEE-0.5 to VDD+0.5	V
LED Driver Output Current	IOLED	+25	mA
VFD Driver Output Current	IOVFD	-40(grid) / -15(segment)	mA

RECOMMENDED OPERATING CONDITIONS

(Ta=-20 to +70°C, GND=0V)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	Unit
Logic Supply Voltage	VDD	4.5	5	5	V
High-Level Input Voltage	VIH	0.7VDD	—	VDD	V
Low-Level Input Voltage	VIL	0	—	0.3VDD	V
Driver Supply Voltage	VEE	0	—	VDD-35	V



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DC/AC ELECTRICAL CHARACTERISTIC

(VDD=5V, GND=0V, VEE=VDD-35V, TA =25°C, unless otherwise noted)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
High-Level Output Voltage	VOHLED	0.9VDD	—	—	V	IOHLED=-1mA, LED1 to LED5
Low-Level Output Voltage	VOLLED	—	—	1	V	IOLLED=+20mA, LED1 to LED5
Low-Level Output Voltage	VOLDout	—	—	0.4	V	DOUt, IOLDOuT=4mA
High-Level Output Current	IOHsg	-3	—	—	mA	VO=VDD-2V, Seg1 to Seg12
High-Level Output Current	VOHGr	-15	—	—	mA	VO=VDD-2V, Grid1 to Grid8, Seg13 / Grid16 to Seg20 / Grid9
High-Level Input Voltage	VIH	0.7VDD	—	—	V	—
Low-Level Input Voltage	VIL	—	—	0.3VDD	V	—
Oscillation Frequency	fosc	350	500	650	KHz	R=51KΩ

SWITCHING CHARACTERISTICS (Ta=-20 to +70°C, VDD=4.5 to 5.5V, VEE=-30V)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Oscillation Frequency	tosc	350	500	650	KHz	R=56KΩ
Propagation Delay Time	tPLZ			300	ns	CLK → Dout CL=15pF, RL=10KΩ
	tPZL			100	ns	
Rise Time	trZH1			2	μs	CL=300pF Seg1 to Seg12 Grid1 to Grid8, Seg13 / Grid16 to Seg20 / Grid9
	trZH2			0.5	μs	
Fall Time	tTHZ			120	μs	CL=300pF, Segn, Gridn
Maximun Clock Frequency	fmax.	1			MHz	Duty=50%
Input Capacitance	CI			15	pF	

TIMING CONDITIONS (Ta=-20 to +70°C, VDD=4.5 to 5.5V)

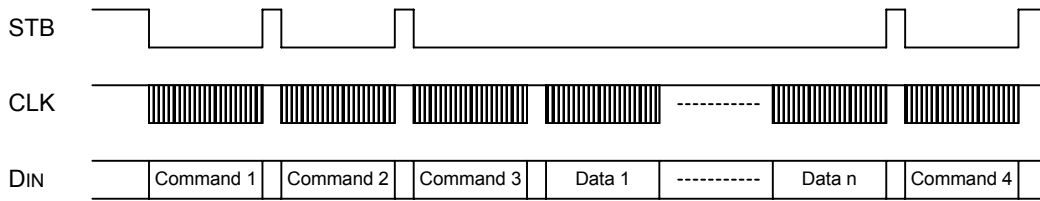
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	TEST CONDITIONS
Clock Pulse Width	PWCLK	400			ns	
Strobe Pulse Width	PWSTB	1			μs	
Data Setup Time	tSETUP	100			ns	
Data Hold Time	tHOLD	100			ns	
Clock-Strobe Time	tCLK-STB	1			μs	CLK ↑ → STB ↑
Wait Time	tWAIT	1			μs	CLK ↑ → CLK ↓



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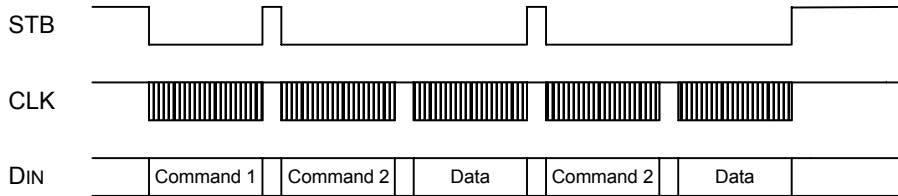
APPLICATIONS

Updating display memory by incrementing address



Command 1 : sets display mode
Command 2 : sets data
Command 3 : sets address
Data 1 to n : transfers display data (48 bytes max.)
Command 4 : controls display

Updating specific address



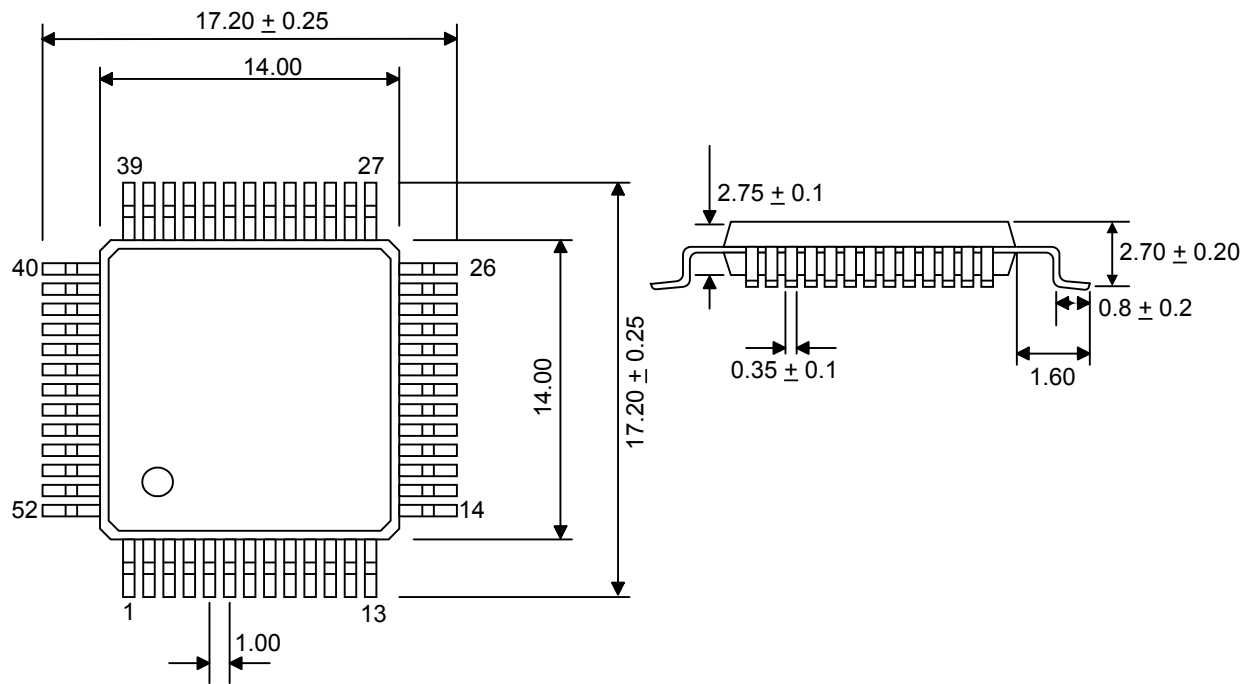
Command 1 : sets date
Command 2 : sets address
Data : display data



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PACKAGE SPEC.

52 PINS QFP DIMENSION



Note: Controlling dimensions are in millimeters (MM).