

# LR36685

Vertical Driver IC for  
CCD Area Sensors

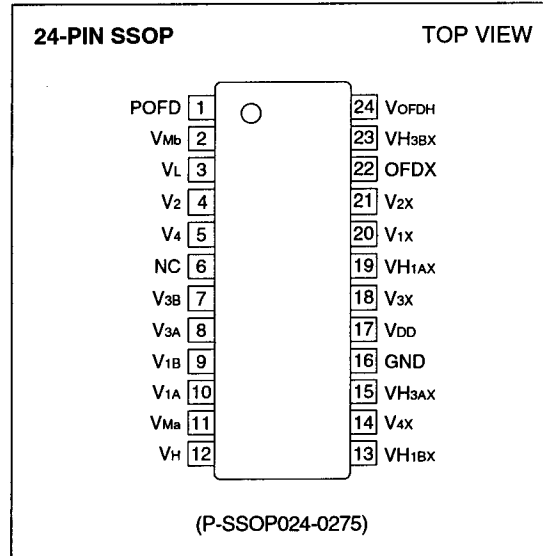
## DESCRIPTION

The LR36685 is a CMOS vertical clock driver and shutter driver IC for CCD area sensors which provides the functions to convert the voltage and impedance from the CMOS level.

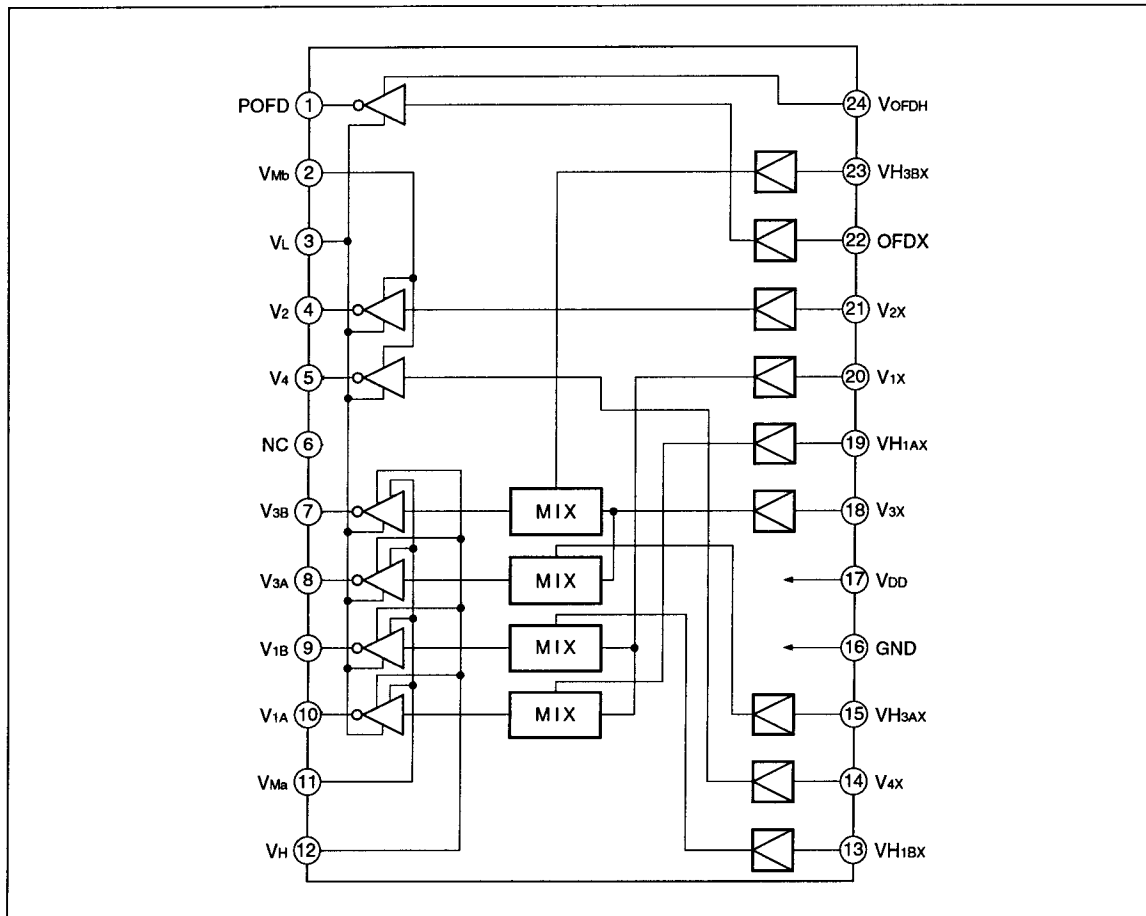
## FEATURES

- Built-in seven circuits
  - 2-level output :
    - 2 circuits for vertical CCD clock driver
    - Output voltage level (TYP.) =  $-9$  to  $0$  V
  - 3-level output :
    - 4 circuits for vertical CCD clock driver
    - Output voltage level (TYP.) =  $-9$  to  $0$  to  $+15$  V
  - 2-level output :
    - 1 circuit for shutter driver
    - Output voltage level (TYP.) =  $-9$  to  $+17$  V
- Switchable between NTSC (EIA) and PAL (CCIR) modes
- Package : 24-pin SSOP (P-SSOP024-0275)

## PIN CONNECTIONS



## BLOCK DIAGRAM



**PIN DESCRIPTION**

| PIN NO. | SYMBOL            | PIN NAME                          | DESCRIPTION                                                                                                        |
|---------|-------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------|
| 1       | POFD              | OFD pulse output                  | An electronic shutter pulse output.<br>(high level = VO <sub>FDH</sub> , low level = V <sub>L</sub> )              |
| 2       | V <sub>Mb</sub>   | Power supply                      | A power supply for high level of V <sub>2</sub> and V <sub>4</sub> .                                               |
| 3       | V <sub>L</sub>    | Power supply                      | A power supply for low level of all output pulses.                                                                 |
| 4       | V <sub>2</sub>    | Vertical transfer pulse output 2  | A pulse to drive vertical CCD shift register.<br>Connect to $\phi$ V <sub>2</sub> .                                |
| 5       | V <sub>4</sub>    | Vertical transfer pulse output 4  | A pulse to drive vertical CCD shift register.<br>Connect to $\phi$ V <sub>4</sub> .                                |
| 6       | NC                | No connection                     | No connection                                                                                                      |
| 7       | V <sub>3B</sub>   | Vertical transfer pulse output 3B | A pulse to drive vertical CCD shift register.<br>Connect to $\phi$ V <sub>3B</sub> .                               |
| 8       | V <sub>3A</sub>   | Vertical transfer pulse output 3A | A pulse to drive vertical CCD shift register.<br>Connect to $\phi$ V <sub>3A</sub> .                               |
| 9       | V <sub>1B</sub>   | Vertical transfer pulse output 1B | A pulse to drive vertical CCD shift register.<br>Connect to $\phi$ V <sub>1B</sub> .                               |
| 10      | V <sub>1A</sub>   | Vertical transfer pulse output 1A | A pulse to drive vertical CCD shift register.<br>Connect to $\phi$ V <sub>1A</sub> .                               |
| 11      | V <sub>Ma</sub>   | Power supply                      | A power supply for intermediate level of V <sub>1A</sub> , V <sub>1B</sub> , V <sub>3A</sub> and V <sub>3B</sub> . |
| 12      | V <sub>H</sub>    | Power supply                      | A power supply for high level of V <sub>1A</sub> , V <sub>1B</sub> , V <sub>3A</sub> and V <sub>3B</sub> .         |
| 13      | VH <sub>1BX</sub> | Readout pulse input 1B            | A pulse that transfers the charge of the photo-diode to the vertical shift register.                               |
| 14      | V <sub>4X</sub>   | Vertical transfer pulse input 4   | A vertical transfer pulse input.                                                                                   |
| 15      | VH <sub>3AX</sub> | Readout pulse input 3A            | A pulse that transfers the charge of the photo-diode to the vertical shift register.                               |
| 16      | GND               | Ground                            | A grounding pin.                                                                                                   |
| 17      | V <sub>DD</sub>   | Power supply                      | A power supply for input pulses.                                                                                   |
| 18      | V <sub>3X</sub>   | Vertical transfer pulse input 3   | A vertical transfer pulse input.                                                                                   |
| 19      | VH <sub>1AX</sub> | Readout pulse input 1A            | A pulse that transfers the charge of the photo-diode to the vertical shift register.                               |
| 20      | V <sub>1X</sub>   | Vertical transfer pulse input 1   | A vertical transfer pulse input.                                                                                   |
| 21      | V <sub>2X</sub>   | Vertical transfer pulse input 2   | A vertical transfer pulse input.                                                                                   |
| 22      | OFDX              | OFD pulse input                   | An electronic shutter pulse input.                                                                                 |
| 23      | VH <sub>3BX</sub> | Readout pulse input 3B            | A pulse that transfers the charge of the photo-diode to the vertical shift register.                               |
| 24      | VO <sub>FDH</sub> | Power supply                      | A power supply for high level of POFD.                                                                             |

**ABSOLUTE MAXIMUM RATINGS**

| PARAMETER           | SYMBOL                              | RATING                             | UNIT | NOTE |
|---------------------|-------------------------------------|------------------------------------|------|------|
| Supply voltage      | V <sub>DD</sub>                     | GND – 0.3 to GND + 6.0             | V    | 1    |
|                     | V <sub>H</sub> – V <sub>L</sub>     | 29.0                               | V    |      |
|                     | V <sub>Ma</sub> , V <sub>Mb</sub>   | V <sub>L</sub> to V <sub>H</sub>   | V    |      |
|                     | V <sub>O</sub> FDH – V <sub>L</sub> | 34.0                               | V    |      |
| Input voltage       | V <sub>IN</sub>                     | GND – 0.3 to V <sub>DD</sub> + 0.3 | V    |      |
| Storage temperature | T <sub>STG</sub>                    | –55 to +150                        | °C   |      |

**NOTE :**

1. V<sub>H</sub> (MIN.) = V<sub>DD</sub>, V<sub>O</sub>FDH (MIN.) = V<sub>DD</sub>, V<sub>L</sub> (MAX.) = GND

**RECOMMENDED OPERATING CONDITIONS**

| PARAMETER             | SYMBOL                              | MIN.               | TYP.   | MAX.                  | UNIT |
|-----------------------|-------------------------------------|--------------------|--------|-----------------------|------|
| Supply voltage        | V <sub>DD</sub>                     | 3.0                | 3.3    | 5.5                   | V    |
|                       | V <sub>H</sub> – V <sub>L</sub>     | 17.0               | 24.0   | 27.0                  | V    |
|                       | V <sub>H</sub>                      | 12.0               | 15.0   | 20.0                  | V    |
|                       | V <sub>L</sub>                      | –10.0              | –9.0   | –5.0                  | V    |
|                       | V <sub>Ma</sub> , V <sub>Mb</sub>   |                    | 0.0    |                       | V    |
|                       | V <sub>O</sub> FDH – V <sub>L</sub> | 17.0               | 26.0   | 32.0                  | V    |
|                       | V <sub>O</sub> FDH                  | 12.0               | 17.0   | 24.0                  | V    |
| Input voltage         | V <sub>IN</sub> (Low)               | 0                  |        | 0.25V <sub>DD</sub>   | V    |
|                       | V <sub>IN</sub> (High)              | 0.8V <sub>DD</sub> |        | V <sub>DD</sub> + 0.2 | V    |
| Operating frequency   | NTSC                                |                    | 15.734 |                       | kHz  |
|                       | PAL                                 |                    | 15.625 |                       | kHz  |
| Operating temperature | T <sub>OPR</sub>                    | –20                |        | +70                   | °C   |

## ELECTRICAL CHARACTERISTICS

## DC Characteristics

(V<sub>DD</sub> = +3.3 V, V<sub>H</sub> = +15.0 V, V<sub>L</sub> = -9.0 V, V<sub>Ma</sub> = V<sub>Mb</sub> = 0 V, V<sub>OFDH</sub> = +17.0 V, T<sub>A</sub> = +25°C)

| PARAMETER                     | SYMBOL             | CONDITIONS                                    | MIN.               | TYP. | MAX.                  | UNIT | NOTE    |
|-------------------------------|--------------------|-----------------------------------------------|--------------------|------|-----------------------|------|---------|
| Input "Low" voltage           | V <sub>IL</sub>    |                                               | 0.0                |      | 0.25V <sub>DD</sub>   | V    |         |
| Input "High" voltage          | V <sub>IH</sub>    |                                               | 0.8V <sub>DD</sub> |      | V <sub>DD</sub> + 0.2 | V    |         |
| Input "Low" current           | I <sub>IL</sub>    | V <sub>IL</sub> = 0 V                         |                    |      | 200                   | μA   |         |
| Input "High" current          | I <sub>IH</sub>    | V <sub>IH</sub> = 3.3 V                       |                    |      | 1.0                   | μA   |         |
| Output "Low" voltage          | V <sub>OL</sub>    | I <sub>OL</sub> < 1 μA                        |                    |      | -8.9                  | V    | 1, 2, 3 |
| Output "High" voltage         | V <sub>OH</sub>    | I <sub>OH</sub> < 1 μA                        | 14.9               |      |                       | V    | 2       |
| Output "High" voltage         | V <sub>OFDH</sub>  | I <sub>OFDH</sub> < 1 μA                      | 16.9               |      |                       | V    | 3       |
| Output "Intermediate" voltage | V <sub>OMLa</sub>  | I <sub>OMLa</sub> < 1 μA                      | -0.1               |      | 0.1                   | V    | 2       |
|                               | V <sub>OMHa</sub>  | I <sub>OMHa</sub> < 1 μA                      | -0.1               |      | 0.1                   | V    |         |
|                               | V <sub>OMLb</sub>  | I <sub>OMLb</sub> < 1 μA                      | -0.1               |      | 0.1                   | V    | 1       |
|                               | V <sub>OMHb</sub>  | I <sub>OMHb</sub> < 1 μA                      | -0.1               |      | 0.1                   | V    |         |
| Output "Low" current          | I <sub>OL</sub>    | V <sub>OL</sub> = V <sub>L</sub> + 0.1 V      | 1.0                |      |                       | mA   | 1, 2, 3 |
| Output "High" current         | I <sub>OH</sub>    | V <sub>OH</sub> = V <sub>H</sub> - 0.1 V      | 1.0                |      |                       | mA   | 2       |
| Output "High" current         | I <sub>OFDH</sub>  | V <sub>OFDH</sub> = V <sub>OFDH</sub> - 0.1 V | 1.0                |      |                       | mA   | 3       |
| Output "Intermediate" current | I <sub>OMLa</sub>  | V <sub>OMLa</sub> = V <sub>M</sub> - 0.1 V    | 1.0                |      |                       | mA   | 2       |
|                               | I <sub>OMHa</sub>  | V <sub>OMHa</sub> = V <sub>M</sub> + 0.1 V    | 1.0                |      |                       | mA   |         |
|                               | I <sub>OMLb</sub>  | V <sub>OMLb</sub> = V <sub>M</sub> - 0.1 V    | 1.0                |      |                       | mA   | 1       |
|                               | I <sub>OMHb</sub>  | V <sub>OMHb</sub> = V <sub>M</sub> + 0.1 V    | 1.0                |      |                       | mA   |         |
| Output ON resistance          | R <sub>ONH</sub>   | I <sub>OH</sub> = 20 mA                       |                    | 30   |                       | Ω    | 2       |
|                               | R <sub>ONOFH</sub> | I <sub>OFDH</sub> = 20 mA                     |                    | 20   |                       | Ω    | 3       |
|                               | R <sub>ONM</sub>   | I <sub>OM</sub> = 20 mA                       |                    | 25   |                       | Ω    | 1, 2    |
|                               | R <sub>ONL</sub>   | I <sub>OL</sub> = 20 mA                       |                    | 20   |                       | Ω    | 1, 2, 3 |
| Static current                | I <sub>DD</sub>    |                                               |                    |      | 2.0                   | mA   |         |
|                               | I <sub>H</sub>     |                                               |                    |      | 200                   | μA   |         |
|                               | I <sub>OFDH</sub>  |                                               |                    |      | 200                   | μA   |         |
|                               | I <sub>M</sub>     |                                               |                    |      | 200                   | μA   |         |
|                               | I <sub>L</sub>     |                                               |                    |      | 200                   | μA   |         |

## NOTES :

1. Applied to outputs (V<sub>2</sub>, V<sub>4</sub>).
2. Applied to outputs (V<sub>1A</sub>, V<sub>1B</sub>, V<sub>3A</sub>, V<sub>3B</sub>).
3. Applied to output (POFD).

**AC Characteristics**

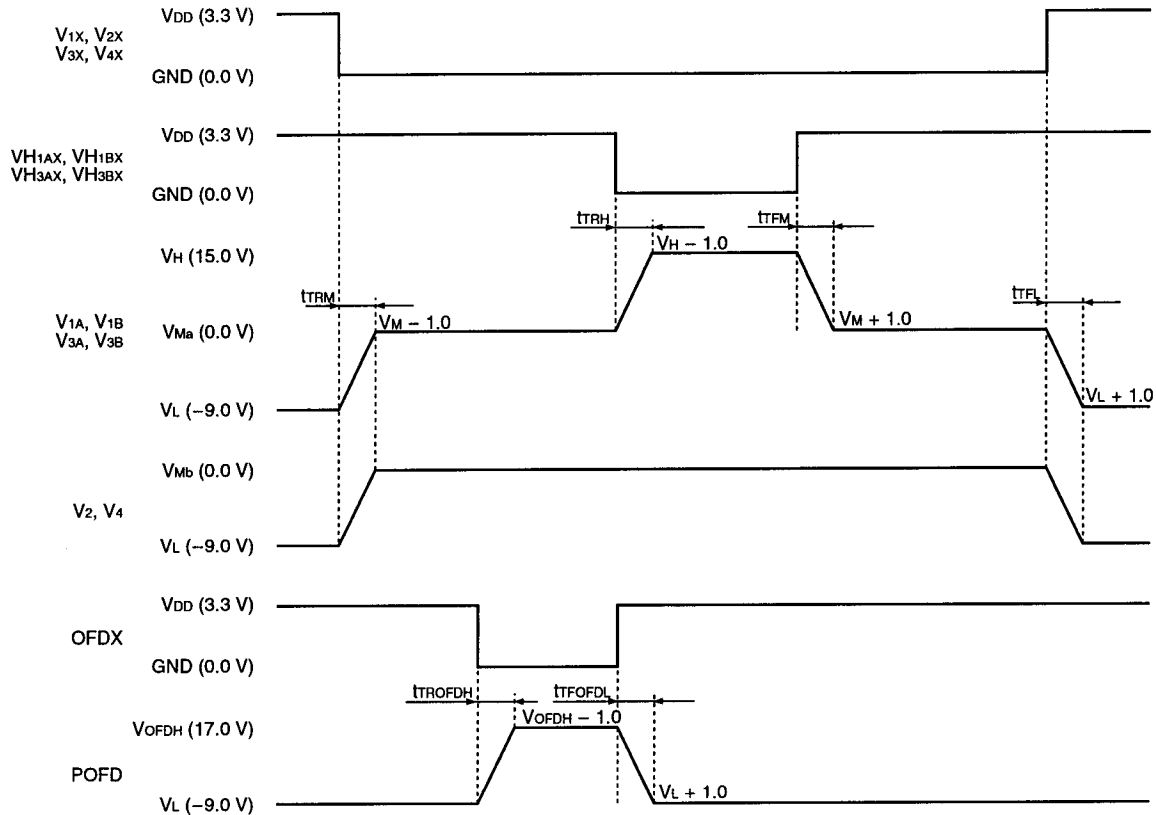
( $V_{DD} = +3.3\text{ V}$ ,  $V_H = +15.0\text{ V}$ ,  $V_L = -9.0\text{ V}$ ,  $V_{Ma} = V_{Mb} = 0\text{ V}$ ,  $V_{OFDH} = +17.0\text{ V}$ ,  $T_A = +25^\circ\text{C}$ ,  
Shutter speed : 1/100 000 s)

| PARAMETER        | SYMBOL                                         | CONDITIONS                                                                         | TYP. | MAX.  | UNIT |
|------------------|------------------------------------------------|------------------------------------------------------------------------------------|------|-------|------|
| Sequential delay | $t_{TRM}$<br>( $V_L \rightarrow V_M$ )         | $V_{IN}$ to $V_M - 1.0\text{ V}$<br>( $V_{1A}, V_{1B}, V_2, V_{3A}, V_{3B}, V_4$ ) | 600  | 1 200 | ns   |
|                  | $t_{TFL}$<br>( $V_M \rightarrow V_L$ )         | $V_{IN}$ to $V_L + 1.0\text{ V}$<br>( $V_{1A}, V_{1B}, V_2, V_{3A}, V_{3B}, V_4$ ) | 600  | 1 200 | ns   |
|                  | $t_{TRH}$<br>( $V_M \rightarrow V_H$ )         | $V_{IN}$ to $V_H - 1.0\text{ V}$<br>( $V_{1A}, V_{1B}, V_{3A}, V_{3B}$ )           | 800  | 1 600 | ns   |
|                  | $t_{TFM}$<br>( $V_H \rightarrow V_M$ )         | $V_{IN}$ to $V_M + 1.0\text{ V}$<br>( $V_{1A}, V_{1B}, V_{3A}, V_{3B}$ )           | 800  | 1 600 | ns   |
|                  | $t_{TROFDH}$<br>( $V_L \rightarrow V_{OFDH}$ ) | $V_{IN}$ to $V_{OFDH} - 1.0\text{ V}$<br>(POFD)                                    | 80   | 160   | ns   |
|                  | $t_{TFOFDL}$<br>( $V_{OFDH} \rightarrow V_L$ ) | $V_{IN}$ to $V_L + 1.0\text{ V}$<br>(POFD)                                         | 80   | 160   | ns   |
| Dynamic current  | $I_{DYN}$                                      | During operation                                                                   | 5    | 10    | mA   |

**NOTE :**

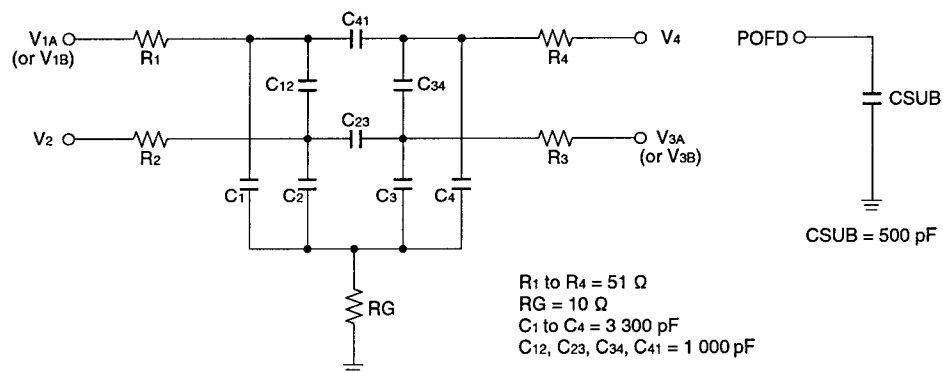
Refer to "Switching Characteristics Conditions" and "Equivalent Circuit".

## Switching Characteristics Conditions



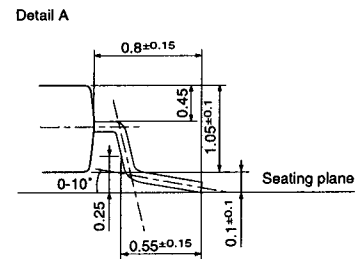
## Equivalent Circuit

(While V<sub>1A</sub> and V<sub>3A</sub> [or V<sub>1B</sub> and V<sub>3B</sub>] are measured, V<sub>1B</sub> and V<sub>3B</sub> [or V<sub>1A</sub> and V<sub>3A</sub>] are open.)



**24 SSOP (P-SSOP024-0275)**

(Unit : mm)



**SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.**

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