

M66310P/FP

16-BIT LED DRIVER WITH SHIFT REGISTER AND LATCH

DESCRIPTION

M66310P/FP is a LED array driver having a 16bit serial-input and parallel output shiftregister function with direct coupled reset input and output latch function.

This product guarantees the output electric current of 24mA which is sufficient for cathode common LED drive, capable of flowing 16bits continuously at the same time.

Parallel output is open drain output.

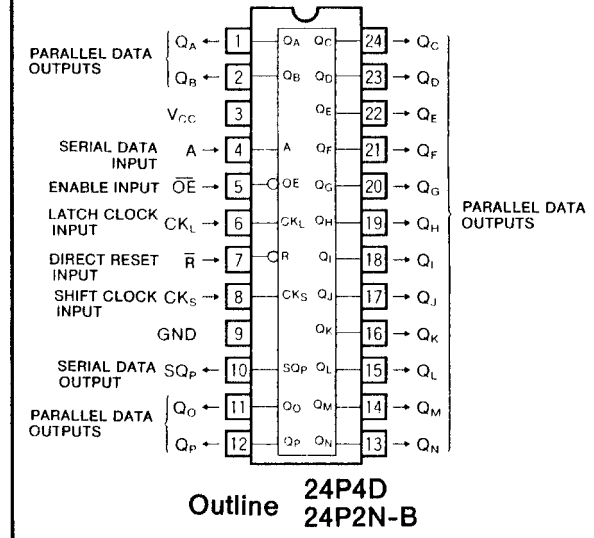
In addition, as this product has been designed in complete CMOS, power consumption can be greatly reduced when compared with conventional BIPOLAR or Bi-CMOS products.

Furthermore, pin lay-out ensures the realization of an easy printed circuit.

FEATURES

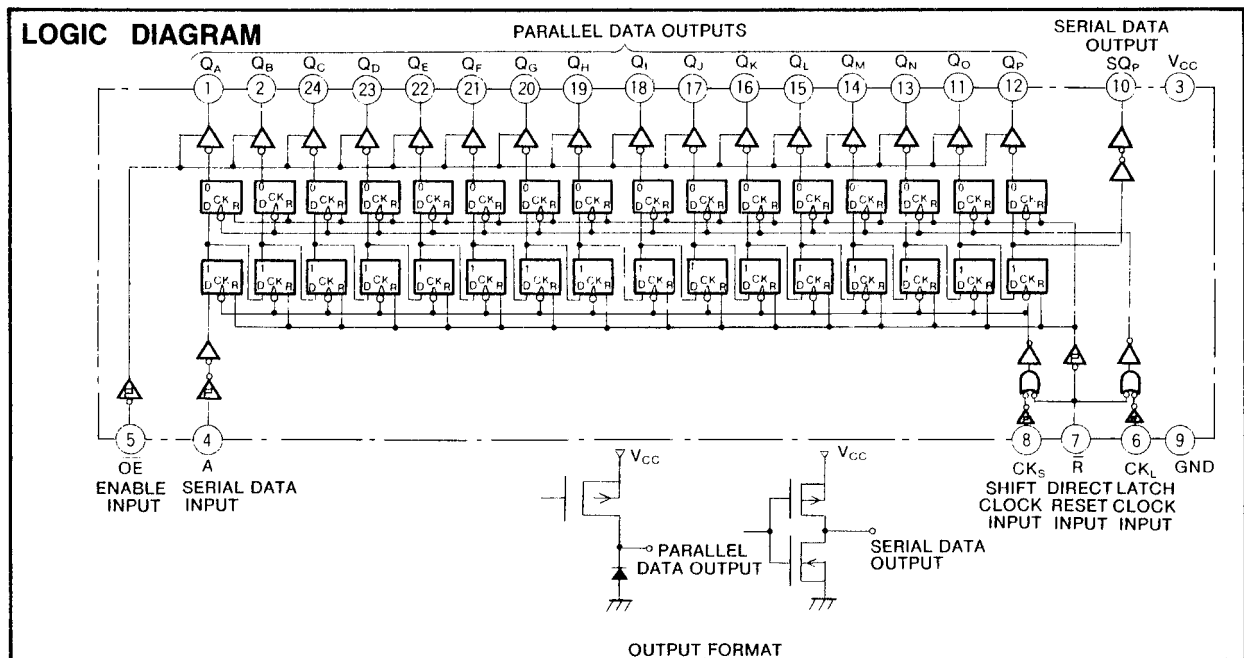
- Cathode common LED drive
- High output current
all parallel output $I_{OH} = -24mA$
simultaneous lighting available
- Low power dissipation : $100\mu W/\text{package (max)}$
($V_{CC} = 5V, T_a = 25^\circ C$, quiescent state)
- High noise margin
schmitt input circuit provides responsiveness to a long line length.
- Equipped with direct-coupled reset
- Open drain output
(except serial data output)
- Wide operating temperature range
: $T_a = -40 \sim +85^\circ C$
- Pin lay-out facilitates printed circuit wiring. (This lay-out facilitates cascade connection and LED connection.)

PIN CONFIGURATION (TOP VIEW)



APPLICATION

- LED array drive of BUTTON TELEPHONE
- LED array drive of ERASER of a PPC copier
- Other various LED modules



16-BIT LED DRIVER WITH SHIFT REGISTER AND LATCH

FUNCTIONAL DESCRIPTION

As M66310P/FP uses silicon gate CMOS process, it realizes high-speed and high-output currents sufficient for LED drive while maintaining low power consumption and allowance for high noises.

Each bit of a shiftregister consists of two flip-flops having independent clocks for shifting and latching.

As for clock input, shift clock input CKs and latch clock input CKL are independent from each other, shift and latch operations being made when "L" changes to "H".

Serial data input A is the data input of the first-step shiftregister and the signal of A shifts shifting registers one by one when a pulse is impressed to CKs. When A is "L", the signal of "L" shifts.

When the pulse is impressed to CKL, the contents of the

shifting register at that time are stored in a latching register, and they appear in the outputs from QA~QP.

Outputs from QA~QP are open drain outputs.

To extend the number of bits, use the serial data output SQP which shows the output of the shifting register of the 16th bit.

If CKs and CKL are connected, the state of the shifting register with one clock delay is outputted to QA~QP.

When reset input R is changed to "L", QA~QP and SQP are reset. In this case, shifting and latching registers are reset.

If "H" is impressed to output enable input OE, QA~QP reaches the high impedance state, but SQP does not reach the high impedance state. Furthermore, change in OE does not affect shift operation.

FUNCTION TABLE (Note : 1)

| Operation mode | Input | | | | | PARALLEL DATA Output | | | | | | | | | | | | | | | | Serial data output SQP | Remarks | |
|-----------------------|----------|-----|-----|---|----|----------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------------|-----------------|-----------------------|
| | R | CKs | CKL | A | OE | QA | QB | QC | QD | QE | QF | QG | QH | QI | QJ | QK | QL | QM | QN | QO | QP | | | |
| Reset | L | X | X | X | X | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | L | — |
| Shift latch operation | Shift t1 | H | ↑ | X | H | L | QA ⁰ | QB ⁰ | QC ⁰ | QD ⁰ | QE ⁰ | QF ⁰ | QG ⁰ | QH ⁰ | QI ⁰ | QJ ⁰ | QK ⁰ | QL ⁰ | QM ⁰ | QN ⁰ | QO ⁰ | QP ⁰ | qO ⁰ | Output lighting "H" |
| | Latch t2 | H | X | ↑ | X | L | H | qA ⁰ | qB ⁰ | qC ⁰ | qD ⁰ | qE ⁰ | qF ⁰ | qG ⁰ | qH ⁰ | qI ⁰ | qJ ⁰ | qK ⁰ | qL ⁰ | qM ⁰ | qN ⁰ | qO ⁰ | qP ⁰ | — |
| | Shift t1 | H | ↑ | X | L | L | QA ⁰ | QB ⁰ | QC ⁰ | QD ⁰ | QE ⁰ | QF ⁰ | QG ⁰ | QH ⁰ | QI ⁰ | QJ ⁰ | QK ⁰ | QL ⁰ | QM ⁰ | QN ⁰ | QO ⁰ | QP ⁰ | qO ⁰ | Output lights-out "L" |
| | Latch t2 | H | X | ↑ | X | L | Z | qA ⁰ | qB ⁰ | qC ⁰ | qD ⁰ | qE ⁰ | qF ⁰ | qG ⁰ | qH ⁰ | qI ⁰ | qJ ⁰ | qK ⁰ | qL ⁰ | qM ⁰ | qN ⁰ | qO ⁰ | qP ⁰ | — |
| Output disable | X | X | X | X | H | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | Z | qP | — |

- Note 1 : ↑ : Change from low-level to high-level
- Q⁰ : Output state Q before CKL changed
- X : Irrelevant
- q⁰ : Contents of shift register before CKs changed
- q : Contents of shift register
- t1, t2 : t2 is set after t1 is set
- Z : High impedance

16-BIT LED DRIVER WITH SHIFT REGISTER AND LATCH

ABSOLUTE MAXIMUM RATINGS (Ta=-40~+85°C, unless otherwise noted)

| Symbol | Parameter | Conditions | Ratings | Unit |
|------------------|--------------------------------|----------------------------------|---------------------------|------|
| V _{CC} | Supply voltage | | -0.5~+7.0 | V |
| V _I | Input voltage | | -0.5~V _{CC} +0.5 | V |
| V _O | Output voltage | | -0.5~V _{CC} +0.5 | V |
| I _{IK} | Input protection diode current | V _I < 0V | -20 | mA |
| | | V _I > V _{CC} | 20 | |
| I _{OK} | Output parasitic diode current | V _O < 0V | -20 | mA |
| | | V _O > V _{CC} | 20 | |
| I _O | Output current per output pin | Q _A ~Q _P | -50 | mA |
| | | SQ _P | ±25 | |
| I _{CC} | Supply/GND current | V _{CC} , GND | -410, +20 | mA |
| P _d | Power dissipation | (Note 2) | 500 | mW |
| T _{stg} | Storage temperature range | | -65~+150 | °C |

Note 2 : M66310FP ; Ta=-40~+70°C, Ta=70~85°C are derated at -6mW/°C.

RECOMMENDED OPERATING CONDITIONS (Ta=-40~+85°C, unless otherwise noted)

| Symbol | Parameter | Limits | | | Unit |
|------------------|-----------------------------|--------|-----|-----------------|------|
| | | Min | Typ | Max | |
| V _{CC} | Supply voltage | 4.5 | 5 | 5.5 | V |
| V _I | Input voltage | 0 | | V _{CC} | V |
| V _O | Output voltage | 0 | | V _{CC} | V |
| T _{opr} | Operating temperature range | -40 | | +85 | °C |

ELECTRICAL CHARACTERISTICS (V_{CC}=4.5~5.5V, unless otherwise noted)

| Symbol | Parameter | Test conditions | Limits | | | | | Unit |
|-----------------|---|--|---------------------------------|----------------------|----------------------|----------------------|----------------------|------|
| | | | Ta=25°C | | | Ta=-40~+85°C | | |
| | | | Min | Typ | Max | Min | Max | |
| V _{T+} | Positive-going threshold voltage | V _O = 0.1V, V _{CC} -0.1V I _O = 20μA | 0.35XV _{CC} | | 0.7XV _{CC} | 0.35XV _{CC} | 0.7XV _{CC} | V |
| V _{T-} | Negative-going threshold voltage | V _O = 0.1V, V _{CC} -0.1V I _O = 20μA | 0.2XV _{CC} | | 0.55XV _{CC} | 0.2XV _{CC} | 0.55XV _{CC} | V |
| V _{OH} | High-level output voltage Q _A ~Q _P | V _I =V _{T+} , V _{T-} V _{CC} =4.5V | I _{OH} =-20μA | V _{CC} -0.1 | | V _{CC} -0.1 | | V |
| | | | I _{OH} =-24mA | 3.83 | | 3.66 | | |
| | | | Note3 I _{OH} =-40mA | 3.50 | | 3.25 | | |
| V _{OH} | High-level output voltage SQ _P | V _I =V _{T+} , V _{T-} V _{CC} =4.5V | I _{OH} =-20μA | V _{CC} -0.1 | | V _{CC} -0.1 | | V |
| | | | I _{OH} =-4mA | 3.83 | | 3.66 | | |
| V _{OL} | Low-level output voltage SQ _P | V _I =V _{T+} , V _{T-} V _{CC} =4.5V | I _{OL} =20μA | | 0.1 | | 0.1 | V |
| | | | I _{OL} =4mA | | 0.44 | | 0.53 | |
| I _{IH} | High-level input current | V _I =V _{CC} , V _{CC} =5.5V | | | 0.5 | | 5.0 | μA |
| I _{IL} | Low-level input current | V _I =GND, V _{CC} =5.5V | | | -0.5 | | -5.0 | μA |
| I _O | Maximum output leakage current Q _A ~Q _P | V _I =V _{T+} , V _{T-} V _{CC} =5.5V | V _O =V _{CC} | | 1.0 | | 10.0 | μA |
| | | | V _O =GND | | -1.0 | | -10.0 | |
| I _{CC} | Quiescent supply current | V _I =V _{CC} , GND, V _{CC} =5.5V | | | 20.0 | | 200.0 | μA |

Note 3 : M66310 is used under the condition of an output current I_{OH}=-40mA, the number of simultaneous drive outputs is restricted as shown in the Duty Cycle-I_{OH} of Standard characteristics.

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SWITCHING CHARACTERISTICS (V_{CC}=5V)

| Symbol | Parameter | Test conditions | Limits | | | | | Unit |
|------------------|--|---|----------------------|-----|-----|---------------------------|-----|------|
| | | | T _a =25°C | | | T _a =-40~+85°C | | |
| | | | Min | Typ | Max | Min | Max | |
| f _{max} | Maximum clock frequency | C _L =50pF R _L =1kΩ (Note 5) | 5 | | | 4 | | MHz |
| t _{PLH} | Low-level to high-level and high-level to low-level | | | | 100 | | 130 | ns |
| t _{PHL} | output propagation time (CK _S -SQ _P) | | | | 100 | | 130 | ns |
| t _{PHL} | High-level to low-level output propagation time (R̄-SQ _P) | | | | 100 | | 130 | ns |
| t _{PHZ} | High-level to low-level output propagation time (R̄-Q _A ~Q _P) | | | | 150 | | 200 | ns |
| t _{PZH} | Low-level to high-level and high-level to low-level | | | | 100 | | 130 | ns |
| t _{PHZ} | output propagation time (CK _L -Q _A ~Q _P) | | | | 150 | | 200 | ns |
| t _{PZH} | Output enable time to low-level and high-level | | | | 100 | | 130 | ns |
| t _{PHZ} | (OE-Q _A ~Q _P) | | | | 150 | | 200 | ns |
| C _I | Input Capacitance | | | | 10 | | 10 | pF |
| C _O | Output Capacitance | OE=V _{CC} | | 15 | | 15 | pF | |
| C _{PD} | Power dissipation Capacitance (Note 4) | | 11 | | | | pF | |

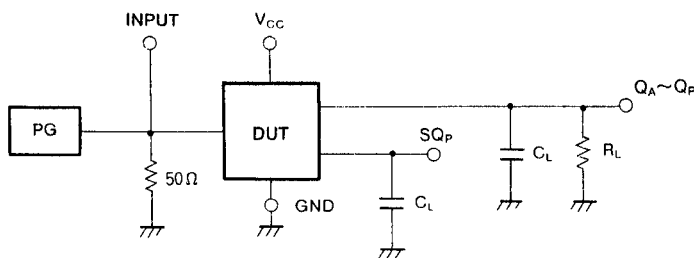
Note 4 : C_{PD} is the internal capacitance of the IC calculated from operation supply current under no-load conditions. (per latch)
 The power dissipated during operation under no-load conditions is calculated using the following formula:
 $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_l + I_{CC} \cdot V_{CC}$

TIMING REQUIREMENTS (V_{CC}=5V)

| Symbol | Parameter | Test conditions | Limits | | | | | Unit |
|------------------|---|-----------------|----------------------|-----|-----|---------------------------|-----|------|
| | | | T _a =25°C | | | T _a =-40~+85°C | | |
| | | | Min | Typ | Max | Min | Max | |
| t _w | CK _S , CK _L , R̄ pulse width | (Note 5) | 100 | | | 130 | | ns |
| t _{su} | A setup time with respect to CK _S | | 100 | | | 130 | | ns |
| t _{su} | CK _S setup time with respect to CK _L | | 100 | | | 130 | | ns |
| t _h | A hold time with respect to CK _S | | 10 | | | 15 | | ns |
| t _{rec} | R̄, recovery time with respect to CK _S , CK _L | | 50 | | | 70 | | ns |

Note 5 : Test Circuit

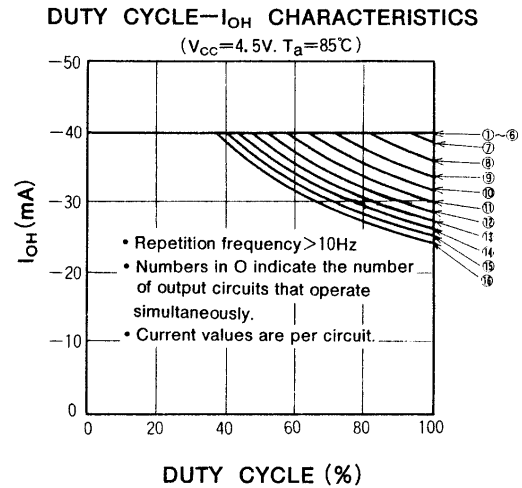
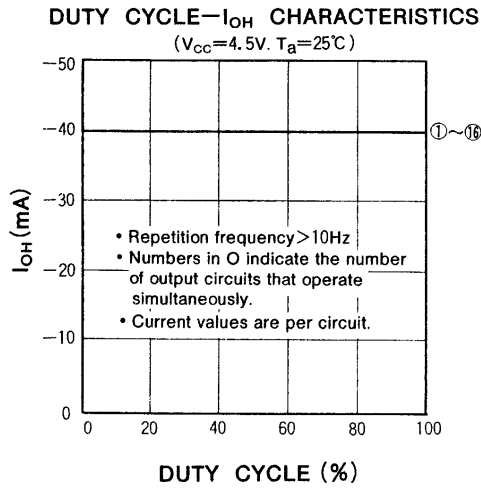
Note 5 : Test Circuit



- (1) The pulse generator (PG) has the following characteristics (10%~90%) : tr=6ns, tf=6ns
- (2) The capacitance CL includes stray wiring capacitance and the probe input capacitance.

16-BIT LED DRIVER WITH SHIFT REGISTER AND LATCH

TYPICAL CHARACTERISTICS



TIMING DIAGRAM

