

# M54972P/FP

## Bi-CMOS 8-BIT SERIAL-INPUT LATCHED DRIVER

### DESCRIPTION

The M54972 is a semiconductor integrated circuit consisting of 8 stages of CMOS shift registers and latches with serial inputs and serial or parallel outputs. It is based on Bi-CMOS process technology, and has 8 bipolar drivers at the parallel outputs.

### FEATURES

- Serial input and serial or parallel output
- Serial output enables cascade connection
- Built-in latch for each stage
- Enable input provides output control
- Low supply current (standby current  $I_{CC} \leq 10\mu A$ )
- Serial I/O level is compatible with typical CMOS devices
- Driver features: High withstand voltage ( $BV_{CEO} \geq 30V$ )  
Capable of large drive currents ( $I_{O(max)}=300mA$ )  
Low output saturation voltage  $V_{OL} < 0.6V$  at  $I_o=300mA$
- Wide operating temperature range  $T_a=-20 - +75^\circ C$

### APPLICATION

Dot drivers for thermal print heads. Serial/parallel conversion. Drivers for relays and solenoids.

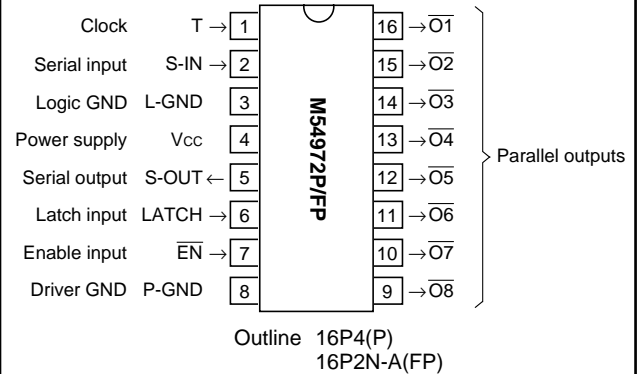
### FUNCTION

The M54972 consists of 8 stages of D-type flip flops connected to 8 latches.

Data is input to serial input S-IN, and clock pulses are input to clock input T. When the clock changes from low to high, the input data enters the first shift register and data already in the shift registers is shifted sequentially.

The serial output S-OUT is used to connect multiple M54972 to expand the number of parallel outputs. S-OUT is connected to S-IN of the next stage.

### PIN CONFIGURATION (TOP VIEW)



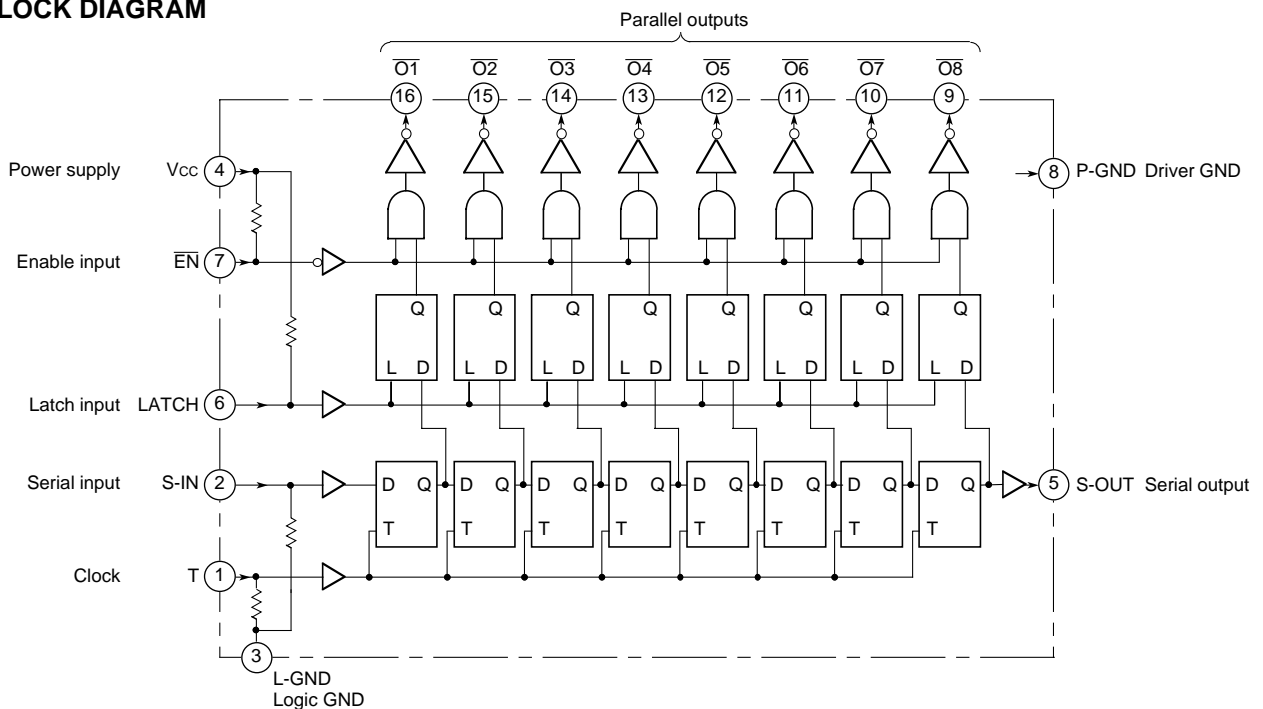
For parallel output. When the clock pulse changes from low to high, latch input (LATCH) is high and output enable input (EN) is low the serial input data at S-IN appears at output O1 and the other data already present is shifted sequentially to outputs O2 through O8.

The parallel outputs are inverted.

When the latch input is held low, the latch retains the stored data. When the EN input is high, outputs O1 through O8 all turn off. As the internal logic is unstable when the power is turned on, the EN input should be kept high (setting outputs O1 through O8 off) until input data is set and the internal logic is initialized.

L-GND is the GND of CMOS logic circuit and P-GND is the GND of output driver circuits O1 through O8 which employ bipolar transistors capable of large drive currents.

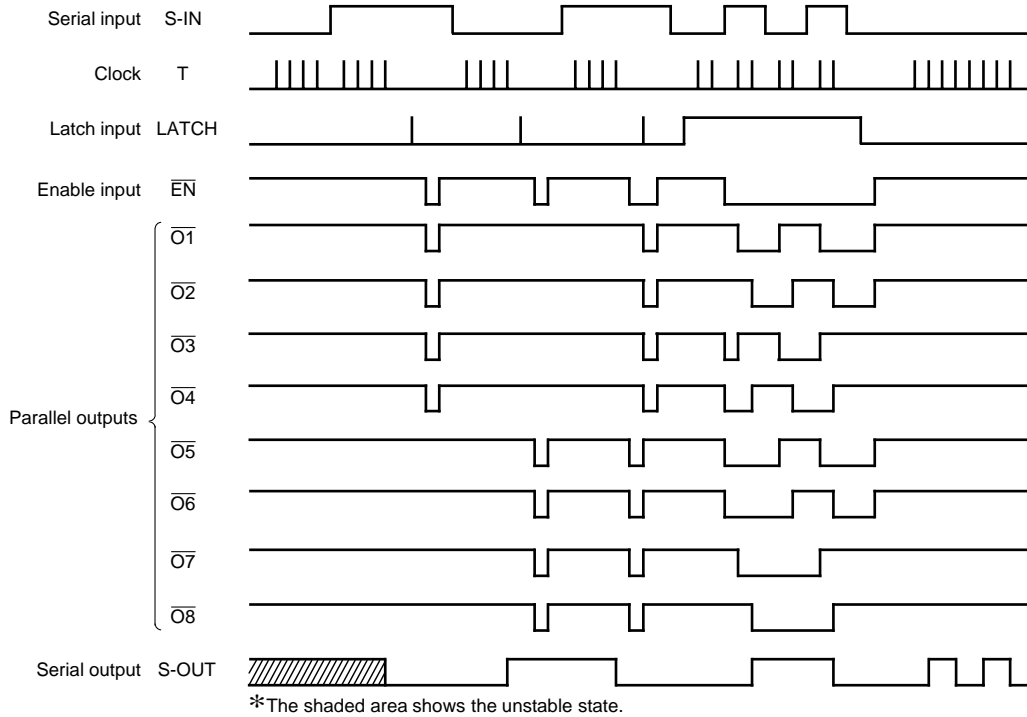
### BLOCK DIAGRAM



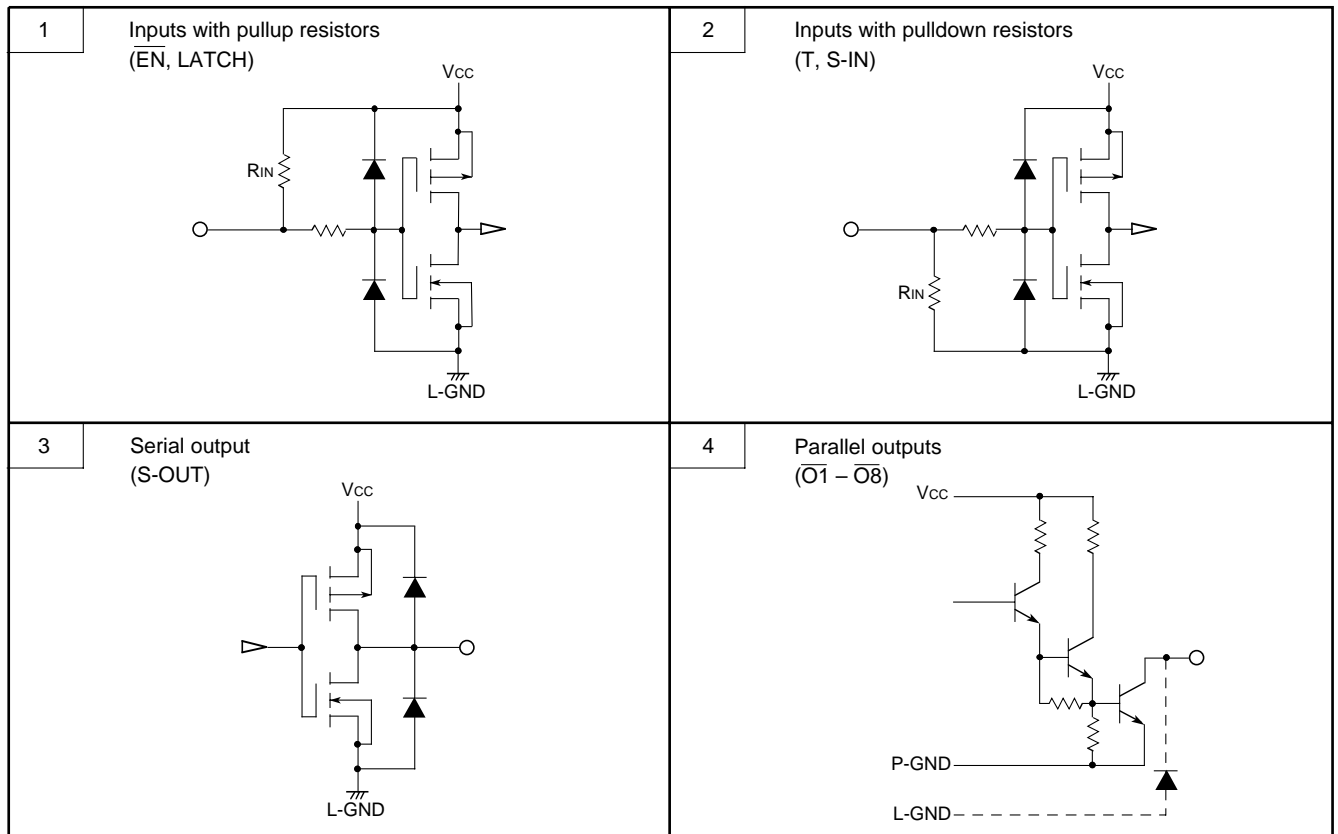
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## Bi-CMOS 8-BIT SERIAL-INPUT LATCHED DRIVER

### TIMING CHART



### INPUT/OUTPUT CIRCUIT DIAGRAM



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## Bi-CMOS 8-BIT SERIAL-INPUT LATCHED DRIVER

**ABSOLUTE MAXIMUM RATINGS** (Ta=-20 to 75°C, unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit	
V <sub>cc</sub>	Supply voltage		-0.5 – +8	V	
V <sub>i</sub>	Input voltage		-0.5 – V <sub>cc</sub> +0.5	V	
V <sub>o</sub>	Output voltage	S-OUT	-0.5 – V <sub>cc</sub> +0.5	V	
		$\overline{O1} - \overline{O8}$ : OFF	-0.5 – +30		
I <sub>o</sub>	Output current	$\overline{O1} - \overline{O8}$ : ON	300	mA	
P <sub>d</sub>	Power dissipation	Ta=25°C	M54972P	1.25	W
			M54972FP	0.8	
T <sub>opr</sub>	Operating temperature		-20 – 75	°C	
T <sub>stg</sub>	Storage temperature		-55 – 125	°C	

**RECOMMENDED OPERATING CONDITION**

Symbol	Parameter	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>cc</sub>	Supply voltage		4	5	6	V
V <sub>o</sub>	Applied output voltage	$\overline{O1} - \overline{O8}$ : OFF			30	V
I <sub>o</sub>	Output current (per circuit)	$\overline{O1} - \overline{O8}$ : ON, Duty cycle < 35%	M54972P		300	mA
		$\overline{O1} - \overline{O8}$ : ON, Duty cycle < 70%		200		
		$\overline{O1} - \overline{O8}$ : ON, Duty cycle < 15%		M54972FP	200	

**ELECTRICAL CHARACTERISTICS** (Ta=25°C, V<sub>cc</sub>=5V, unless otherwise noted)

Symbol	Parameter		Test conditions	Limits			Unit	
				Min.	Typ.	Max.		
V <sub>IH</sub>	High-level input voltage		Ta=-20 – 75°C, V <sub>cc</sub> =4 – 6V	0.7V <sub>cc</sub>		V <sub>cc</sub>	V	
V <sub>IL</sub>	Low-level input voltage			0		0.3V <sub>cc</sub>	V	
I <sub>IH</sub>	High-level input current	T, S-IN	V <sub>IH</sub> =5V		100		μA	
I <sub>IL</sub>	Low-level input current	$\overline{EN}$ , LATCH	V <sub>IL</sub> =0V		-100		μA	
R <sub>IN</sub>	Input resistance			50			kΩ	
V <sub>OH</sub>	High-level output voltage	S-OUT	I <sub>o</sub>   ≤ 1μA	4.9			V	
V <sub>OL</sub>	Low-level output voltage	S-OUT				0.1	V	
I <sub>OH</sub>	High-level output current	S-OUT	V <sub>OH</sub> =4.5V	-100			μA	
I <sub>OL</sub>	Low-level output current	S-OUT	V <sub>OL</sub> =0.4V	400			μA	
V <sub>OL1</sub>	Low-level output voltage	$\overline{O1} - \overline{O8}$	I <sub>oL</sub> =200mA			0.5	V	
V <sub>OL2</sub>							0.6	V
V <sub>OL3</sub>								
I <sub>OLK</sub>	Output leak current	$\overline{O1} - \overline{O8}$	V <sub>o</sub> =30V ( $\overline{O1} - \overline{O8}$ : OFF)			50	μA	
I <sub>CC1</sub>	Supply current		Input: open, All driver outputs: OFF			10	μA	
I <sub>CC2</sub>			One driver output is ON.			7.5	mA	

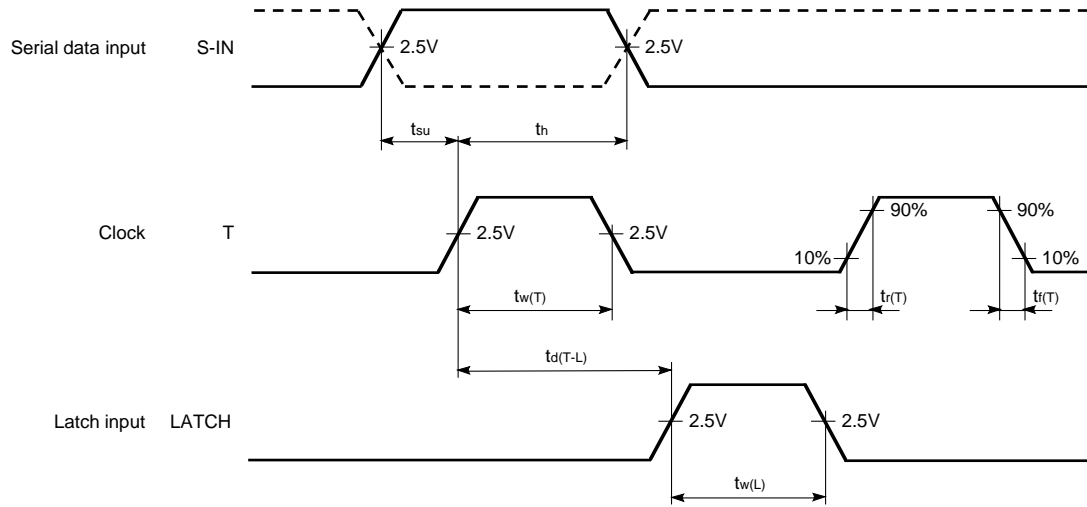
**TIMING REQUIREMENTS** (Ta=-20 to 75°C, unless otherwise noted)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
f <sub>(T)</sub>	Clock frequency	Input duty cycle: 40 – 60%			2	MHz
t <sub>w(T)</sub>	Clock pulse width		200			ns
t <sub>w(L)</sub>	Latch pulse width		200			ns
t <sub>su</sub>	Data setup time		100			ns
t <sub>h</sub>	Data hold time		100			ns
t <sub>d(T-L)</sub>	Clock-latch time		400			ns
t <sub>r(T)</sub>	Clock pulse rise time				500	ns
t <sub>f(T)</sub>	Clock pulse fall time				500	ns

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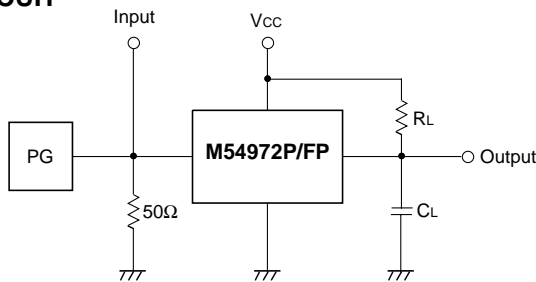
### TIMING CHART



### SWITCHING CHARACTERISTICS (Ta=25°C, VCC=5V, unless otherwise noted)

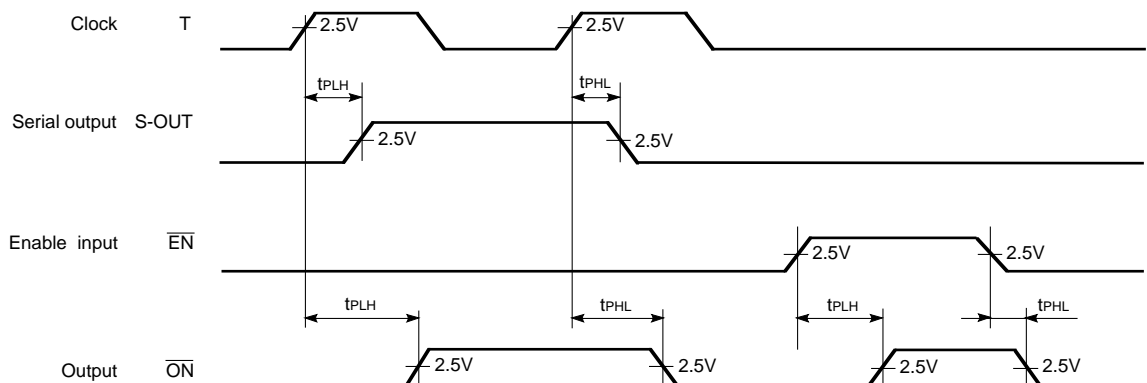
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
tPLH	Low-to-high-level output propagation time From input T to output S-OUT	VIH=5V VIL=0V RL(S-OUT)=∞ RL(ON)=100Ω (N=1-8) CL=15pF			0.3	μs
tPHL	High-to-low-level output propagation time From input T to output S-OUT				0.3	μs
tPLH	Low-to-high-level output propagation time From input T to output ON				10	μs
tPHL	High-to-low-level output propagation time From input T to output ON				5	μs
tPLH	Low-to-high-level output propagation time From input EN to output ON				10	μs
tPHL	High-to-low-level output propagation time From input EN to output ON				5	μs

### TEST CIRCUIT



- The input waveform:  
tr ≤ 20ns, tr ≤ 20ns
- The capacitance CL includes the stray wiring capacitance and probe input capacitance.

### TIMING CHART





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