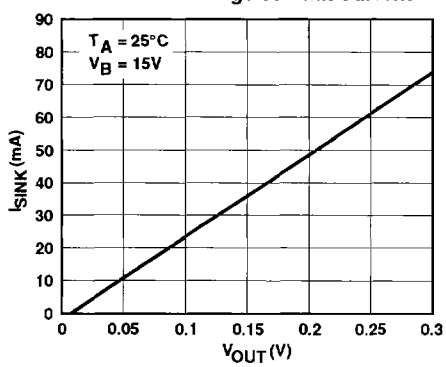
16-BIT PARALLEL-LATCHED OUTPUT PERIPHERAL DRIVER

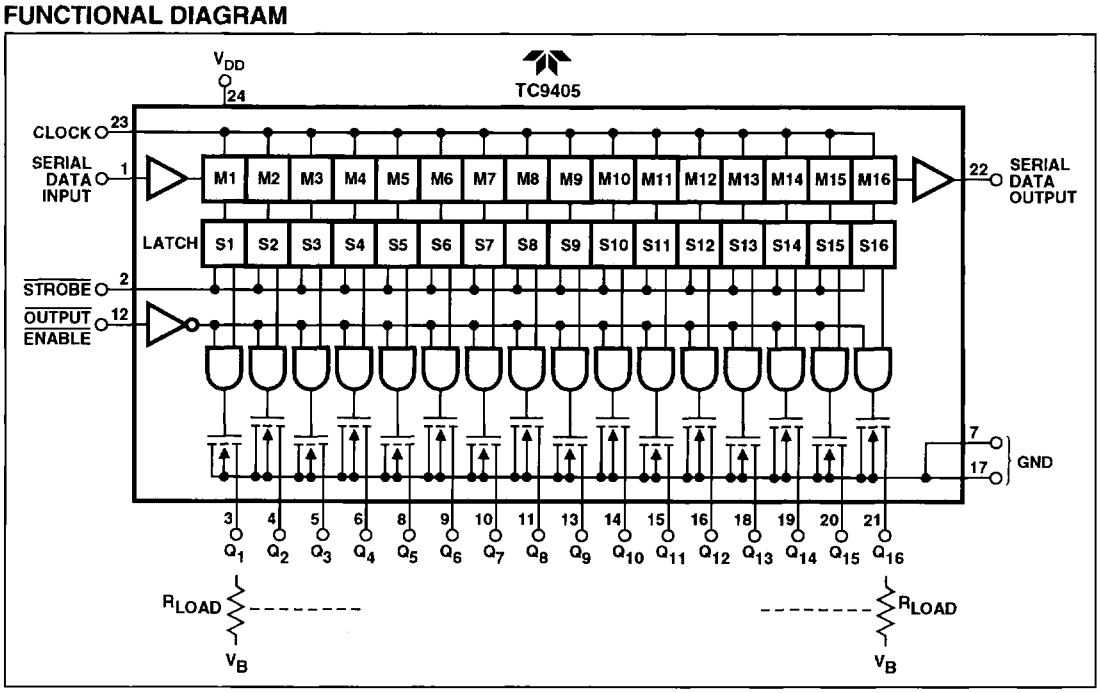
Saturation Voltage vs Sink Current



FEATURES

- High Voltage Outputs 15V
- High Output Current Sink Capability ..... 60 mA
- Low Standby Power ..... 1 mW
- High-Speed Operation ..... 3 MHz
- 16 Latched Parallel Outputs
- Cascading Possible for Longer Data Words
- Dual-Rank Latches and $\overline{\text{STROBE}}$ Input for Ripple-Free Data Update
- $\overline{\text{OUTPUT ENABLE}}$ Input Disables Outputs Without Corrupting Data

FUNCTIONAL DIAGRAM



11

16-BIT PARALLEL-LATCHED OUTPUT PERIPHERAL DRIVER

TC9405

GENERAL DESCRIPTION

The TC9405 is a serial input, 16-bit parallel-latched output shift register. Master/slave data latches and high output power MOS switching transistors combine to make the TC9405 an ideal interface circuit between microprocessor I/O ports and high current/voltage peripherals. The CMOS construction limits quiescent power dissipation to 1 mW.

The TC9405 common-source, open-drain MOS outputs sustain 15V in the OFF state and maintain leakage currents under 100 μA. The low output ON resistance allows all 16 channels to simultaneously sink 60 mA with a saturation voltage of 0.5V maximum and power dissipation of 480 mW. Typical power dissipation of 16 channels sinking 60 mA is only 325 mW.

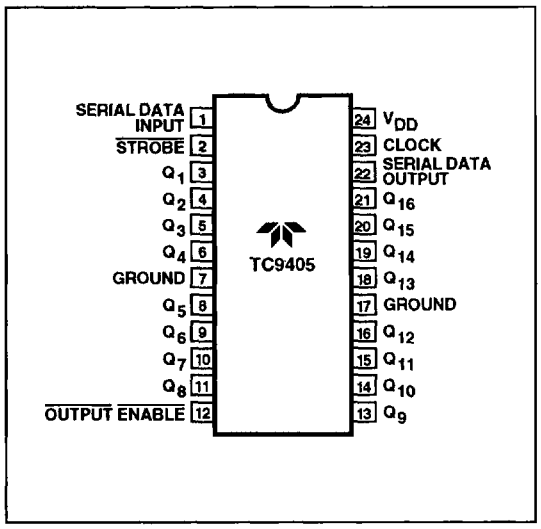
Dual rank latches and a $\overline{\text{STROBE}}$ input permit glitch-free data updating. With the $\overline{\text{STROBE}}$ input high, data is entered into master latches on each rising edge of the CLOCK input. When $\overline{\text{STROBE}}$ is brought low, data is transferred to the slave latches simultaneously. An $\overline{\text{OUTPUT ENABLE}}$ ($\overline{\text{OE}}$) input is also included, so that all outputs can be turned off. Both $\overline{\text{STROBE}}$ and $\overline{\text{OUTPUT ENABLE}}$ are asynchronous, level-sensitive inputs.

Successive connection of serial data outputs to serial data inputs make longer length serial-to-parallel conversions possible. Device cascading makes the TC9405 an ideal thermal printhead, high-resolution LED bar-graph, or incandescent lamp driver.

APPLICATIONS

- **Incandescent Lamp Driver**
- **Thermal Printhead Driver**
- **LED Bar-Graph Driver**
- **High Current, Microprocessor Serial Port Expander**
- **Relay/Solenoid Driver**
- **Tungsten Lamp Driver**
- **SCR Gate Driver**

PIN CONFIGURATIONS



ORDERING INFORMATION

Part	Package	Temperature Range	Output Voltage
TC9405CPG	24-Pin Plastic DIP	0°C to +70°C	15V
TC9405IJG	24-Pin CerDIP	–25°C to +85°C	15V
TC9405MJG	24-Pin CerDIP	–55°C to +125°C	15V

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_{DD} to Ground) 7V
Digital Logic Input voltage 5.5V
Parallel Output Drain Voltage 18V
Parallel Output Drain Current . . . . . 80 mA
Package Power Dissipation
CerDIP Package . . . . . 1W @ 85°C
CerDIP Package . . . . . 0.4W @ 125°C
Epoxy Package . . . . . 1W @ 70°C

Operating Temperature
CerDIP Package (IJG) . . . . . $-25°C \leq T_A \leq +85°C$
CerDIP Package (MJG) . . . . . $-55°C \leq T_A \leq +125°C$
Epoxy Package (CPG) . . . . . $0°C \leq T_A \leq +70°C$
Storage Temperature . . . . . $-65°C \leq T_A \leq +150°C$
Lead Temperature (Soldering, 60 sec) . . . . . +300°C

ELECTRICAL CHARACTERISTICS

V_{DD} = 5V T_A
TC9405C . . . . . 0°C to +70°C
TC9405I . . . . . –25°C to +85°C
TC9405M . . . . . –55°C to +125°C

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Input						
V_{INH}	Logic 1 Input Voltage	V_{DD} = 5.25V	2.4	—	—	V
V_{INL}	Logic 0 Input Voltage	V_{DD} = 5.25V	—	—	0.8	V
I_{INH}	Logic 1 Input Current	V_{INH} = 2.4V V_{DD} = 5.25V	—	—	40	µA
I_{INL}	Logic 0 Input Current	V_{INL} = 0.8V V_{DD} = 5.25V	—	—	40	µA
C_{IN}	Input Capacitance	V_{IN} = 0V	—	15	—	pF
V_{OH}	Serial Output Logic 1 Voltage	I_{OH} = 400 µA I_{OH} = 10 µA	2.4 4.5	4.7 4.98	— —	V V
V_{OL}	Serial Output Logic 0 Voltage	I_{OL} = 3.6 mA	—	—	0.4	V
Output						
V_{SAT}	Output ON Voltage	I_O = 60 mA V_{DD} = 4.75V, T_A = 24°C (Note 2)	—	0.25	0.4	V
V_{SAT}	Output ON Voltage	I_O = 60 mA V_{DD} = 4.75V, T_A = FULL (Note 2)	—	—	0.6	V
V_B	Output OFF Voltage				15	V
I_O	Output Sink Current	$V_{SAT} \leq 0.6V$ (Note 1)	60	—	—	mA
I_{OX}	Output Leakage Current	V_{DD} = 4.75V V_B = 15V	—	—	100	µA

11

TC9405

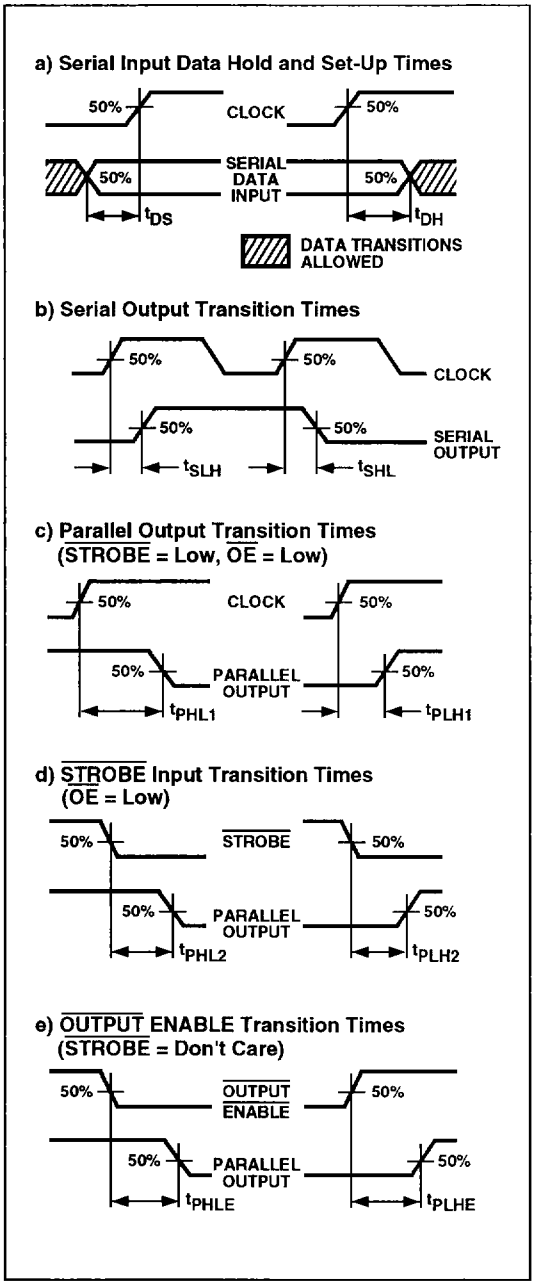
ELECTRICAL CHARACTERISTICS (Cont.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Timing						
t_{DH}	Serial Input Data Hold Time	T_A = 25°C	40	20	—	ns
t_{DS}	Serial Input Data Set-Up Time	T_A = 25°C	50	0	—	ns
f_C	Maximum Clock Frequency	T_A = 25°C	3	5	—	MHz
t_{PW}	Clock Pulse Width	T_A = 25°C	150	100	—	ns
t_{PLH1}	Parallel Output Low-to-High Transition Time	$\overline{STROBE}$ = LOW $\overline{OE}$ = LOW (Note 3 and Figure 1)	—	—	300	ns
t_{PHL1}	Parallel Output High-to-Low Transition Time	$\overline{STROBE}$ = LOW $\overline{OE}$ = LOW (Note 3 and Figure 1)	—	—	300	ns
t_{PLH2}	Parallel Output Low-to-High Transition Time	$\overline{STROBE}$ = ↘ $\overline{OE}$ = LOW (Note 3 and Figure 1)	—	—	300	ns
t_{PLHL2}	Parallel Output High-to-Low Transition Time	$\overline{STROBE}$ = ↘ $\overline{OE}$ = LOW (Note 3 and Figure 1)	—	—	300	ns
t_{PLHE}	Parallel Output Low-to-High Transition Time	$\overline{STROBE}$ = Don't Care $\overline{OE}$ = ↗ (Note 3 and Figure 1)	—	—	250	ns
t_{PHLE}	Parallel Output High-to-Low Transition Time	$\overline{STROBE}$ = Don't Care $\overline{OE}$ = ↘ (Note 3 and Figure 1)	—	—	250	ns
t_{SHL}	Serial Output High-to-Low Transition Time	I_{OL} = 3.6 mA C_L = 25 pF, T_A = 25°C	—	—	150	ns
t_{SLH}	Serial Output Low-to-High Transition Time	I_{OH} = 400 µA C_L = 25 pF, T_A = 25°C	—	—	150	ns
t_{SPW}	Strobe Pulse Width	T_A = 25°C	80	—	—	ns
Supply						
V_{DD}	Operating Supply Voltage		+4.75	+5	+5.25	V
I_S	Quiescent Power Supply	V_{DD} = 5.25V, f_C = 0 Hz V_{INL} = 0V, I_O = 0 mA Pin 22 Open	—	50	200	µA

NOTES:

1. Maintain die temperature ≤ 150°C.
2. V_{SAT} increases by 0.1V when all outputs are sinking 60 mA due to internal ground drop and self-heating.
3. V_B = 15V, R_L = 330Ω, C_L = 25 pF, T_A = 25°C.

Figure 1. Timing Diagrams



FUNCTION TABLE

$\overline{OE}$	$\overline{STROBE}$	Data Input (D_N)	Clock Input	Parallel Outputs Q_1	Q_2	Q_3	...Q_{16}
L	L	X	L	D_1	D_2	D_3	...D_{16}
L	L	H	↗	L*	D_1	D_2	...D_{15}
L	L	L	↗	H*	D_1	D_2	...D_{15}
L	H	X	X	Maintains Last Valid State			
H	X	X	X	H*	H*	H*	H*

L = Logic 0
H = Logic 1
L* = Output NMOS ON
H* = Output NMOS OFF
X = Don't Care
↗ = Transition from low-to-high
D_1, D_2, ...D_{16} = Data outputs before the low-to-high transition of the clock

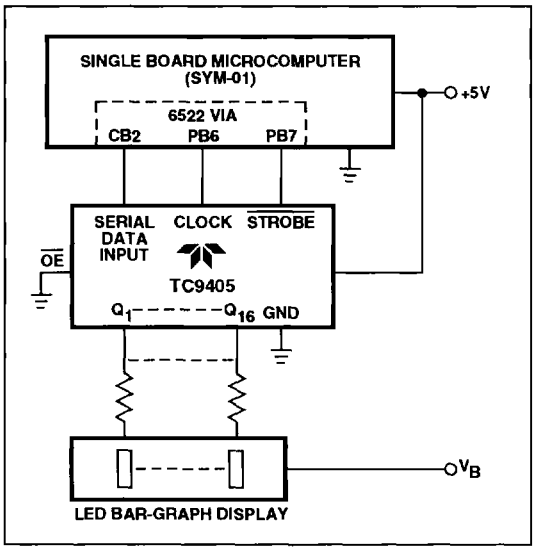
NOTE: $\overline{OE}$ and $\overline{STROBE}$ inputs are level-sensitive, not edge-triggered.

11

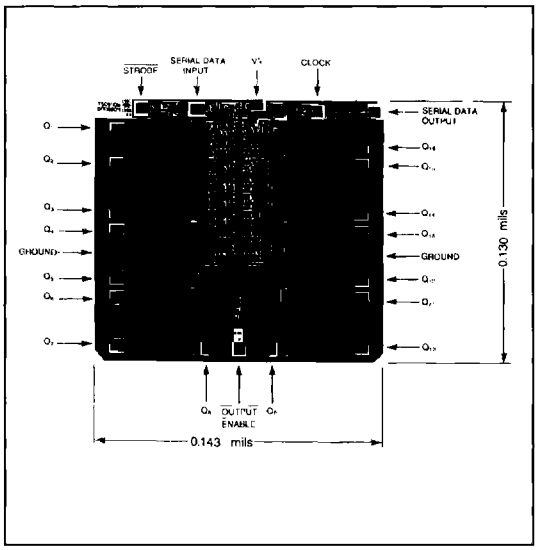
TC9405

APPLICATIONS

MICROPROCESSOR CONTROLLED LED BAR-GRAPH DISPLAY



BONDING DIAGRAM



THERMAL PRINTHEAD DRIVER