Memory/Clock Drivers

MH0025/MH0025C two phase MOS clock driver

general description

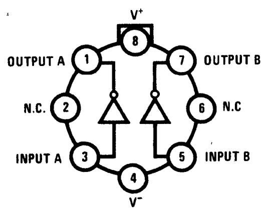
The MH0025/MH0025C is monolithic, low cost, two phase MOS clock driver that is designed to be driven by TTL/DTL line drivers or buffers such as the DM932, DM8830, or DM7440. Two input coupling capacitors are used to perform the level shift from TTL/DTL to MOS logic levels. Optimum performance in turn-off delay and fall time are obtained when the output pulse is logically controlled by the input. However, output pulse widths may be set by selection of the input capacitors eliminating the need for tight input pulse control.

features

- 8-lead TO-5 or 8-lead dual-in-line package
- High Output Voltage Swings—up to 30V
- High Output Current Drive Capability—up to 1.5A
- Rep. Rate: 1.0 MHz into > 1000 pF
- Driven by DM932, DM8830, DM7440(SN7440)
- "Zero" Quiescent Power

connection diagrams

Metal Can Package

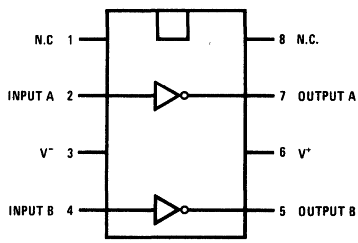


Note: Pin 4 connected to case.

TOP VIEW

Order Number MH0025H or MH0025CH
See Package 11

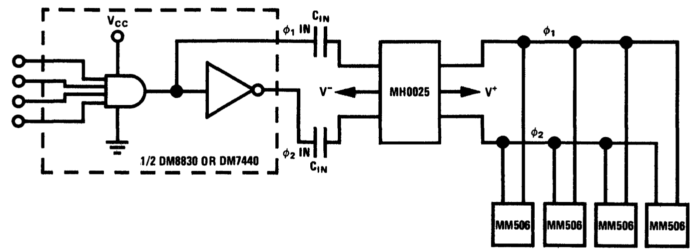
Dual-In-Line Package



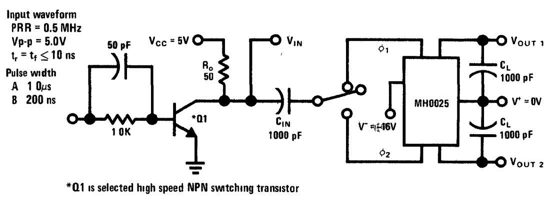
TOP VIEW

Order Number MH0025CN
See Package 20

typical application

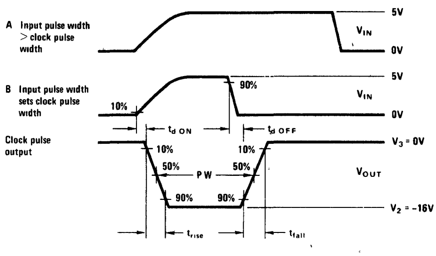


ac test circuit



*Q1 is selected high speed NPN switching transistor

timing diagram



absolute maximum ratings

$(V^+ - V^-)$ Voltage Differential	30V
Input Current	100 mA
Peak Output Current	1.5A
Power Dissipation	See Curves
Storage Temperature	−65°C to +150°C
Operating Temperature MH0025	−55°C to +125°C
MH0025C	0°C to +85°C
Lead Temperature (Soldering, 10 sec)	300°C

electrical characteristics (Note 1) See test circuit.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
T_{dON}	$C_{IN} = .001\ \mu F$, $R_{IN} = 0\Omega$, $C_L = .001\ \mu F$		15	30	ns
T_{rise}			25	50	ns
T_{dOFF} (Note 2)			30	60	ns
T_{fall} (Note 2)		60	90	120	ns
T_{fall} (Note 3)		100	150	250	ns
P.W. (50% to 50%) (Note 3)			500		ns
Positive Output Voltage Swing	$V_{IN} = 0V$, $I_{OUT} = -1$ mA	$V^+ - 1.0$	$V^+ - 0.7V$		V
Negative Output Voltage Swing	$I_{IN} = 10$ mA, $I_{OUT} = 1$ mA		$V^- + 0.7V$	$V^- + 1.5V$	V

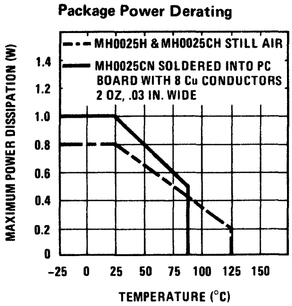
Note 1. Min/Max limits apply across the guaranteed operating temperature range of −55°C to +125°C for MH0025 and 0°C to 85°C for MH0025C. Typical values are for +25°C.

Note 2. Parameter values apply for clock pulse width determined by input pulse width.

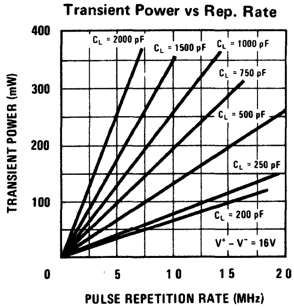
Note 3. Parameter values apply for input pulse width greater than output clock pulse width.

typical performance

Package Power Derating

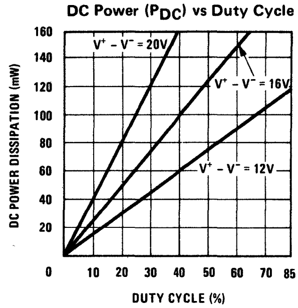


Transient Power vs Rep. Rate



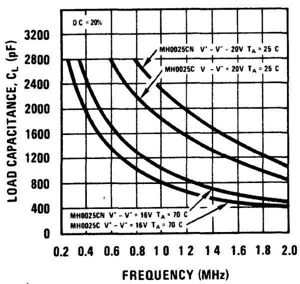
$P_{AC} = (V^+ - V^-)^2 f C_L$

DC Power (P_{DC}) vs Duty Cycle



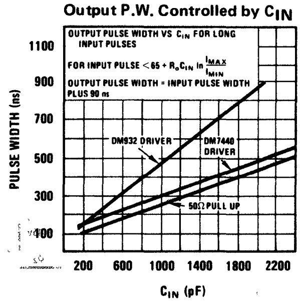
$P_{DC} = \frac{(V^+ - V^-)^2 (DC)}{1k}$

Maximum Load Capacitance



$C_L \leq \frac{(P_{MAX})(1k) - (V^+ - V^-)^2 (DC)}{(f)(1k)(V^+ - V^-)^2} \leq \frac{(I_{pk})(t_r)}{V^+ - V^-}$

Output P.W. Controlled by C_{IN}



I_{MAX} = Peak current delivered by driver

$I_{MIN} \cong \frac{V_{BE}}{R1} = \frac{0.6}{1k}$

applications information

Circuit Operation

Input current forced into the base of Q_1 through the coupling capacitor C_{IN} causes Q_1 to be driven into saturation, swinging the output to $V^- + V_{CE}(sat) + V_{Diode}$.

When the input current has decayed, or has been switched, such that Q_1 turns off, Q_2 receives base drive through R_2, turning Q_2 on. This supplies current to the load and the output swings positive to $V^+ - V_{BE}$.

It may be noted that Q_1 must switch off before Q_2 begins to supply current, hence high internal transients currents form V^- to V^+ cannot occur.

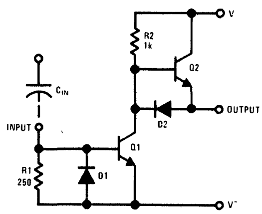


FIGURE 1. MH0025 Schematic (One-Half Circuit)

Fan-Out Calculation

The drive capability of the MH0025 is a function of system requirements, i.e. speed, ambient temperature, voltage swing, drive circuitry, and stray wiring capacity.

The following equations cover the necessary calculations to enable the fan-out to be calculated for any system condition.

Transient Current

The maximum peak output current of the MH0025 is given as 1.5A. Average transient current required from the driver can be calculated from:

$$I = \frac{C_L\,(V^+ - V^-)}{t_r} \qquad (1)$$

Typical rise times into 1000 pF load is 25 ns For $V^+ - V^- = 20V$, $I = 0.8A$.

Transient Output Power

The average transient power (P_{ac}) dissipated, is equal to the energy needed to charge and discharge the output capacitive load (C_L) multiplied by the frequency of operation (f).

$$P_{AC} = C_L \times (V^+ - V^-)^2 \times f \qquad (2)$$

For $V^+ - V^- = 20V$, $f = 1.0$ MHz, $C_L = 1000$ pF, $P_{AC} = 400$ mW.

Internal Power

"0" State Negligible (<3 mW)

"1" State

$$P_{int} = \frac{(V^+ - V^-)^2}{R_2} \times \text{Duty Cycle} \qquad (3)$$

$$= 80 \text{ mW for } V^+ - V^- = 20V,\ DC = 20\%$$

Package Power Dissipation

Total average power = transient output power + internal power

example calculation

How many MM506 shift registers can be driven by an MH0025CN driver at 1 MHz using a clock pulse width of 200 ns, rise time 30-50 ns and 16V amplitude over the temperature range 0-70°C?

Power Dissipation:

At 70°C the MH0025CN can dissipate 630 mW when soldered into printed circuit board.

Transient Peak Current Limitation:

From equation (1), it can be seen that at 16V and 30 ns, the maximum load that can be driven is limited to 2800 pF.

Average Internal Power:

Equation (3), gives an average power of 50 mW at 16V and a 20% duty cycle.

For one half of the MH0025C, 630 mW ÷ 2 can be dissipated.

315 mW = 50 mW + transient output power

265 mW = transient output power

Using equation (2) at 16V, 1 MHz and 250 mW, each half of the MH0025CN can drive a 975 pF load. This is, less than the load imposed by the transient current limitation of equation (1) and so a maximum load of 975 pF would prevail.

From the data sheet for the MM506, the average clock pulse load is 80 pF. Therefore the number of devices driven is $\frac{975}{80}$ or 12 registers.