



MMC 22925/6/7/8

4-DIGIT COUNTERS WITH MULTIPLEXED 7-SEGMENT OUTPUT DRIVERS

GENERAL DESCRIPTION

These CMOS counters consist of a 4-counter, an internal output latch, NPN output sourcing drivers for a 7-segment display and an internal multiplexing circuitry with four multiplexing outputs. The multiplexing circuit has its own free-running oscillator and requires no external clock. The counters advance on negative edge of clock. A high signal on the Reset input will reset the counter to zero and reset the carry-out low. A low signal on the Latch Enable input will latch the number in the counters into the internal output latches. A high signal on Display Select input will select the number in the counter to be displayed; a low level signal on the Display Select will select the number in the output latch to be displayed.

The MMC 22925 is a 4-decade counter and has Latch Enable, Clock and Reset inputs (16 pins package).

The MMC 22926 is like the MMC 22925 except that it has a Display Select and a Carry-Out used for cascading counters.

The Carry-Out signal goes high at 6000 and goes back low at 0000.

The MMC 22927 is like the MMC 22926 except that the second most significant digit divides by 6 rather than 10. Thus, if the clock input frequency is 10 Hz, the display would read tenths of seconds and minutes (i.e., 9:59:9).

The MMC 22928 is like the MMC 22926 except that the most significant digit divides by 2 rather than 10 and the Carry Out is an overflow indicator which goes high at 2000, and goes back low only when the counter is reset. Thus, this is a 3 1/2-digit counter.

FEATURES

- Supply voltage range 3 V to 6 V
- Internal multiplexing circuitry
- High segment sourcing current: 40 mA at $V_{OUT} = V_{DD} - 1.6 \text{ V}$, $V_{DD} = 5 \text{ V}$
- Guaranteed noise margin 1 V

ABSOLUTE MAXIMUM RATINGS

V_{DD}^*	Supply voltage	-0.3	to	6.5	V
V_I	Input voltage	-0.3	to	$V_{DD} + 0.3$	V
I_I	DC input current (any one input)			± 10	mA
P_{tot}	Total power dissipation	Refer to $P_{D(MAX)}$		vs T_A	Graph
T_A	Operating temperature	0	to	70	C
T_{stg}	Storage temperature	-40	to	125	C

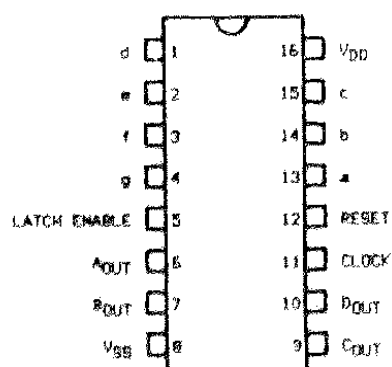
RECOMMENDED OPERATING CONDITIONS

V_{DD}^*	Supply voltage	3	to	6	V
V_I	Input voltage	0	to	V_{DD}	V
T_A	Operating temperature	0	to	70	C

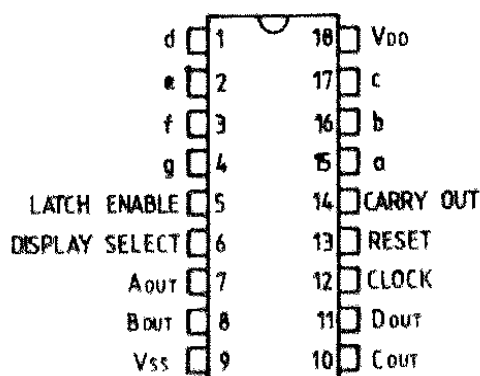
* All voltage values are referred to V_{SS} pin voltage

CONNECTION DIAGRAM - MMC 22925

MMC 22925

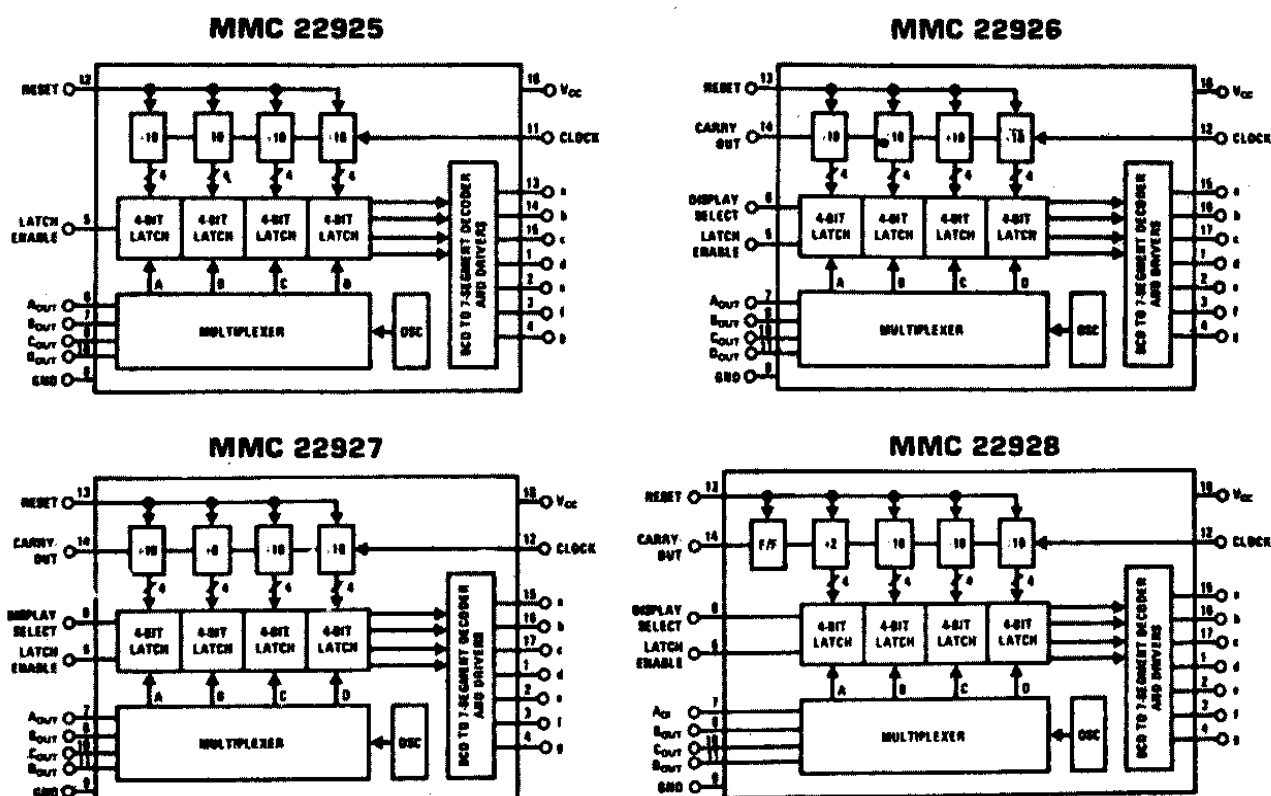


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FUNCTIONAL DESCRIPTION

- Reset — Asynchronous, active high
 Display Select — High, displays output of counter
 — Low, displays output of latch
 Latch Enable — High, flow through condition
 — Low, latch condition
 Clock — Negative edge sensitive
 Digit Output — Current sourcing with 1 mA $V_{OUT} = 1.75$ V. Also sink capability = 2 LTTL loads
 Carry-out — 2 LTTL loads (see carry-out waveforms)
 Segment Output — Current sourcing with 80 mA $V_{OUT} = V_{DD} - 1.6$ V typical ($T_j = 25$ °C). Also sink capability = 2 LTTL loads.

BLOCK DIAGRAM**STATIC ELECTRICAL CHARACTERISTICS**

(over recommended operating conditions)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
CMOS TO CMOS INTERFACE					
V_{IN} (1) Logical "1" Input Voltage	$V_{CC} = 5.0$ V	3.5			V
V_{IN} (0) Logical "0" Input Voltage	$V_{CC} = 5.0$ V			1.5	V
V_{OUT} (1) Logical "1" Output Voltage (Carry-Out and Digit Output Only)	$V_{CC} = 5.0$ V, $I_O = -10$ μ A	4.5			V
V_{OUT} (0) Logical "0" Output Voltage	$V_{CC} = 5.0$ V, $I_O = 10$ μ A			0.5	V
I_{IN} (1) Logical "1" Input Current	$V_{CC} = 5.0$ V, $V_{IN} = 5$ V		0.005	1.0	μ A
I_{IN} (0) Logical "0" Input Current	$V_{CC} = 5.0$ V, $V_{IN} = 0$ V	-1.0	-0.005		μ A
I_{CC} Supply Current	$V_{CC} = 5.0$ V, Outputs Open Circuit, $V_{IN} = 0$ V or 5 V		20	1000	μ A

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OUTPUT DRIVE					
V_{OUT} Output Voltage (Segment Sourcing Output)	$I_{OUT} = -65\text{mA}$, $V_{CC} = 5\text{V}$, $T_j = 25^\circ\text{C}$		$V_{CC} - 1.3$		V
	$I_{OUT} = -40\text{mA}$, $V_{CC} = 5\text{V}$, $\begin{cases} T_j = 100^\circ\text{C} & V_{CC} - 1.6 \\ T_j = 150^\circ\text{C} & V_{CC} - 2 \end{cases}$		$V_{CC} - 1.2$ $V_{CC} - 1.4$		V V
R_{ON} Output Resistance (Segment Sourcing Output)	$I_{OUT} = -65\text{mA}$, $V_{CC} = 5\text{V}$, $T_j = 25^\circ\text{C}$		20		Ω
	$I_{OUT} = -40\text{mA}$, $V_{CC} = 5\text{V}$, $\begin{cases} T_j = 100^\circ\text{C} \\ T_j = 150^\circ\text{C} \end{cases}$		30 35	40 50	Ω Ω
Output Resistance (Segment Output) Temperature Coefficient			0.6	0.8	$\%/^\circ\text{C}$
I_{SOURCE} Output Source Current (Digit Output)	$V_{CC} = 4.75\text{V}$, $V_{OUT} = 1.75\text{V}$, -1 $T_j = 150^\circ\text{C}$		-2		mA
I_{SOURCE} Output Source Current (Carry-out)	$V_{CC} = 5\text{V}$, $V_{OUT} = 0\text{V}$, $T_j = 25^\circ\text{C}$	-1.75	-3.3		mA
I_{SINK} Output Sink Current (All Outputs)	$V_{CC} = 5\text{V}$, $V_{OUT} = V_{CC}$, $T_j = 25^\circ\text{C}$	1.75	3.6		mA
ϕ_{JA}^* Thermal Resistance	MMC 22925 MMC 22926/7/8		75 70	100 90	$^\circ\text{C}/\text{W}$ $^\circ\text{C}/\text{W}$

* ϕ_{JA} measured in free-air with device soldered into printed circuit board

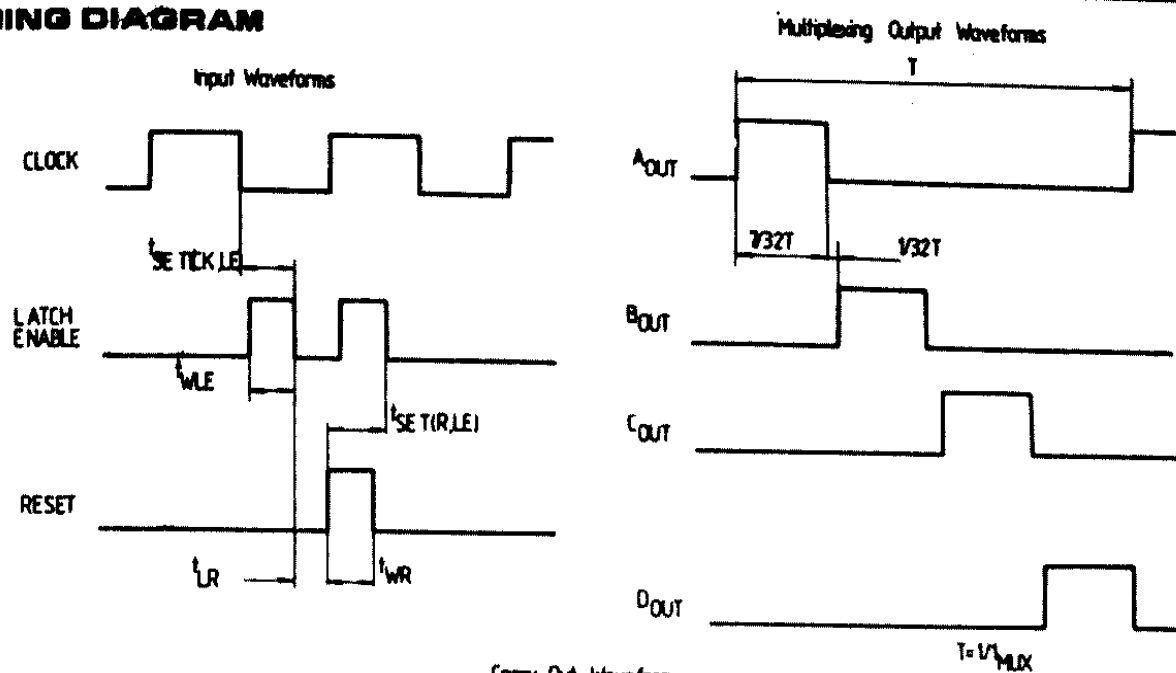
DYNAMIC ELECTRICAL CHARACTERISTICS

$T_j = 25^\circ\text{C}$, $C_L = 50\text{ pF}$, unless otherwise specified

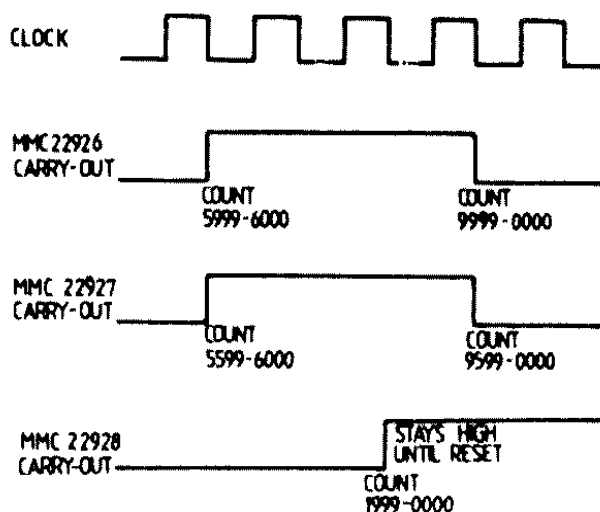
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{MAX} Maximum Clock Frequency	$V_{CC} = 5.0\text{V}$, $T_j = 25^\circ\text{C}$ Square Wave Clock $T_j = 100^\circ\text{C}$	2 1.5	4 3		MHz MHz
t_r , t_f Maximum Clock Rise or Fall Time	$V_{CC} = 5.0\text{V}$			15	μs
t_{WR} Reset Pulse Width	$V_{CC} = 5.0\text{V}$, $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$	250 320	10 125		ns ns
t_{WLE} Latch Enable Pulse Width	$V_{CC} = 5.0\text{V}$, $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$	250 320	100 125		ns ns
$t_{SETICK,LE}$ Clock Latch Enable Set-Up Time	$V_{CC} = 5.0\text{V}$, $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$	2500 3200	1250 1600		ns ns
t_{LR} Latch Enable to Reset Wait Time	$V_{CC} = 5.0\text{V}$, $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$	0 0	-100 -100		ns ns
$t_{SETIRLE}$ Reset to Latch Enable Set-Up Time	$V_{CC} = 5.0\text{V}$, $T_j = 25^\circ\text{C}$ $T_j = 100^\circ\text{C}$	320 400	160 200		ns ns
f_{MUX} Multiplexing Output Frequency	$V_{CC} = 5.0\text{V}$		1000		Hz
C_{IN} Input Capacitance	Any Input		5		pF

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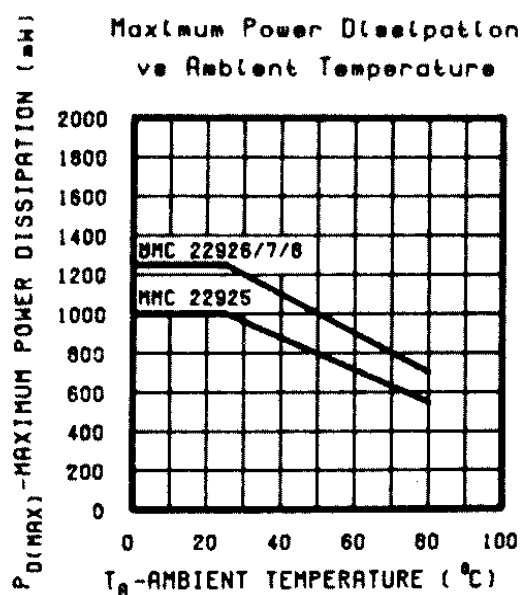
TIMING DIAGRAM



Carry-Out Waveforms



TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL APPLICATION

