4-DIGIT COUNTERS WITH MULTIPLEXED 7-SEGMENT OUTPUT DRIVERS

GENERAL DESCRIPTION

Theese 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 secound 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 $V_{OUT} = V_{DD} - 1.6$ V, $V_{DD} = 5$ 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
Tstg	Storae 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 voluies are referred to V_{SS} pin voltaqe

CONNECTION DIAGRAM - MMC 22925
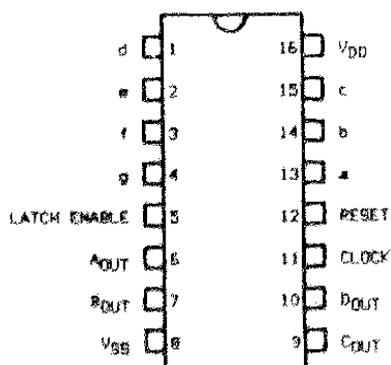
MMC 22925

MMC 22925/6/7/8
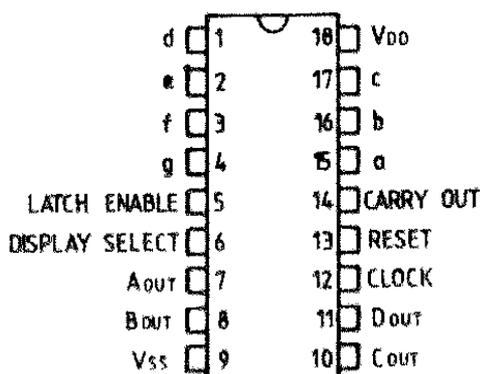
FUNCTIONAL DESCRIPTION

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

MMC 22925

MMC 22926

MMC 22927

MMC 22928
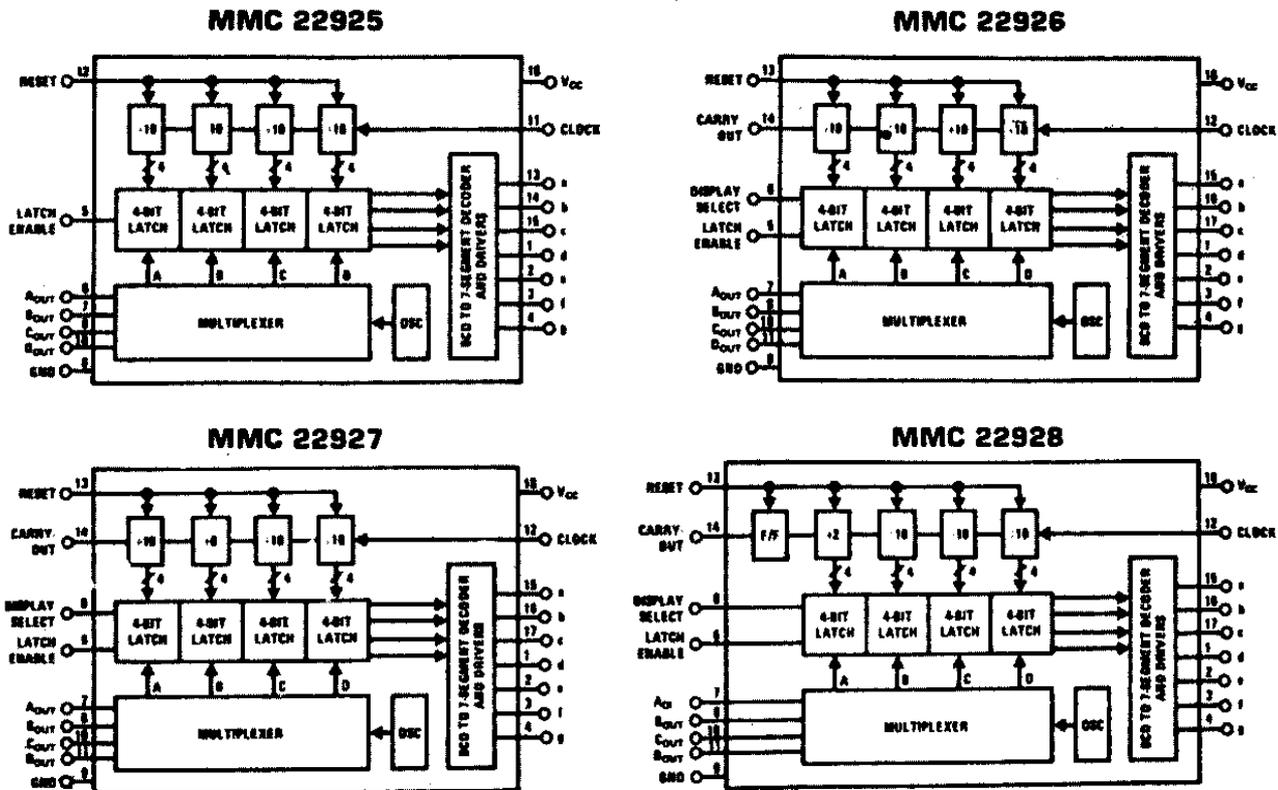
STATIC ELECTRICAL CHARACTERISTICS

(over recommended operating conditions)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
CMOS TO CMOS INTERFACE					
V_{IN} (1) Logical "1" Input Voltage	$V_{CC} = 5.0V$	3.5			V
V_{IN} (0) Logical "0" Input Voltage	$V_{CC} = 5.0V$			1.5	V
V_{OUT} (1) Logical "1" Output Voltage (Carry-Out and Digit Output Only)	$V_{CC} = 5.0V, I_0 = -10\mu A$	4.5			V
V_{OUT} (0) Logical "0" Output Voltage	$V_{CC} = 5.0V, I_0 = 10\ \mu A$			0.5	V
I_{IN} (1) Logical "1" Input Current	$V_{CC} = 5.0V, V_{IN} = 5V$		0.005	1.0	μA
I_{IN} (0) Logical "0" Input Current	$V_{CC} = 5.0V, V_{IN} = 0V$	-1.0	-0.005		μA
I_{CC} Supply Current	$V_{CC} = 5.0V$, Outputs Open Circuit, $V_{IN} = 0V$ or 5 V		20	1000	μA

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

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

DYNAMIC ELECTRICAL CHARACTERISTICS

$T_j = 25°C$, $C_L = 50$ pF, unless otherwise specified

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

TIMING DIAGRAM

Input Waveforms

CLOCK

$t_{SE\,T(CK,LE)}$

LATCH ENABLE

t_{WLE}

$t_{SE\,T(R,LE)}$

RESET

t_{LR} — t_{WR}

Multiplexing Output Waveforms

T

A_{OUT}

7/32T   1/32T

B_{OUT}

C_{OUT}

D_{OUT}

$T = 1/f_{MUX}$

Carry-Out Waveforms

CLOCK

MMC 22926
CARRY-OUT

COUNT
5999-6000

COUNT
9999-0000

MMC 22927
CARRY-OUT

COUNT
5599-6000

COUNT
9599-0000

MMC 22928
CARRY-OUT

STAYS HIGH
UNTIL RESET

COUNT
1999-0000
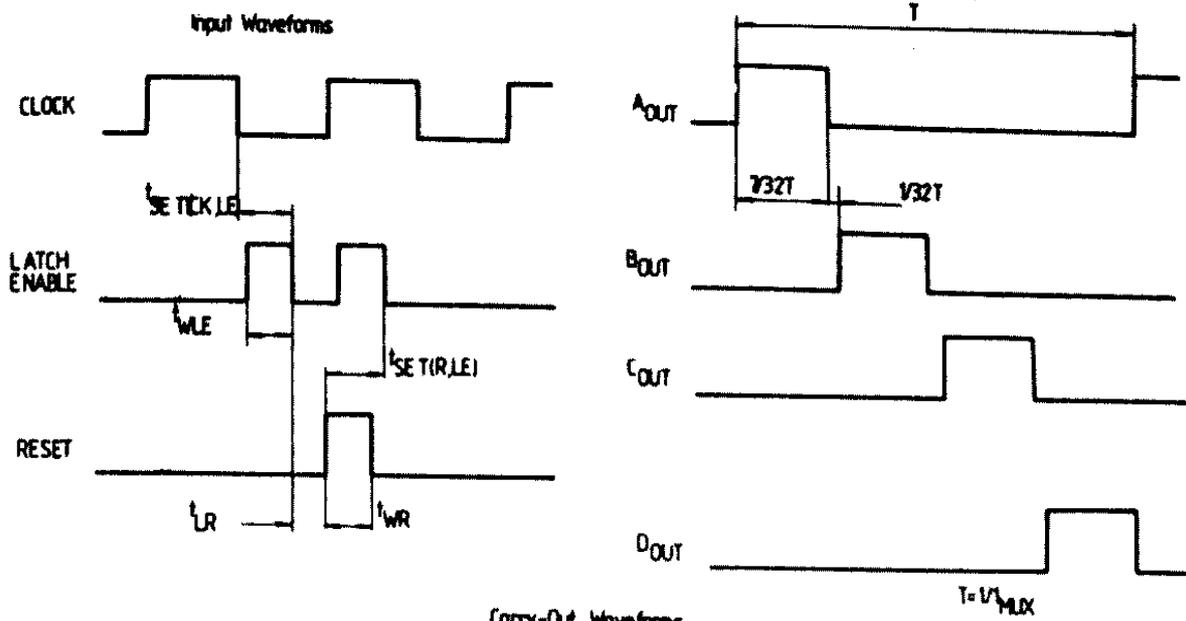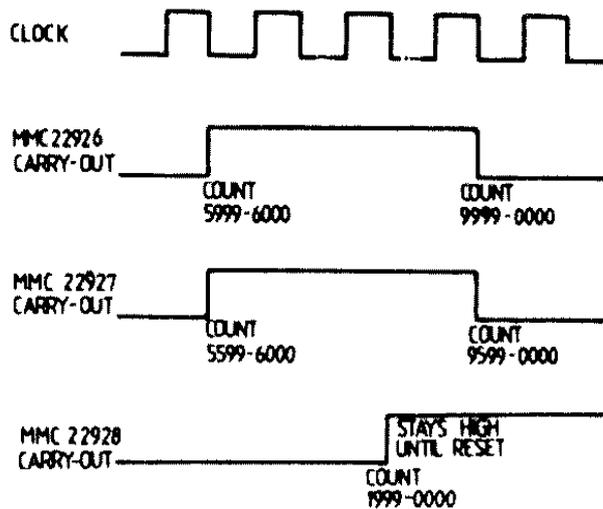
TYPICAL PERFORMANCE CHARACTERISTICS

Maximum Power Dissipation vs Ambient Temperature

$P_{D(MAX)}$ – MAXIMUM POWER DISSIPATION (mW)

MMC 22926/7/8

MMC 22925

T_A – AMBIENT TEMPERATURE (°C)

TYPICAL APPLICATION

Common Cathode LED Display

Segment identification

$$0 \ / \ 2 \ 3 \ 4$$
$$5. \ 6 \ 7 \ 8 \ 9$$