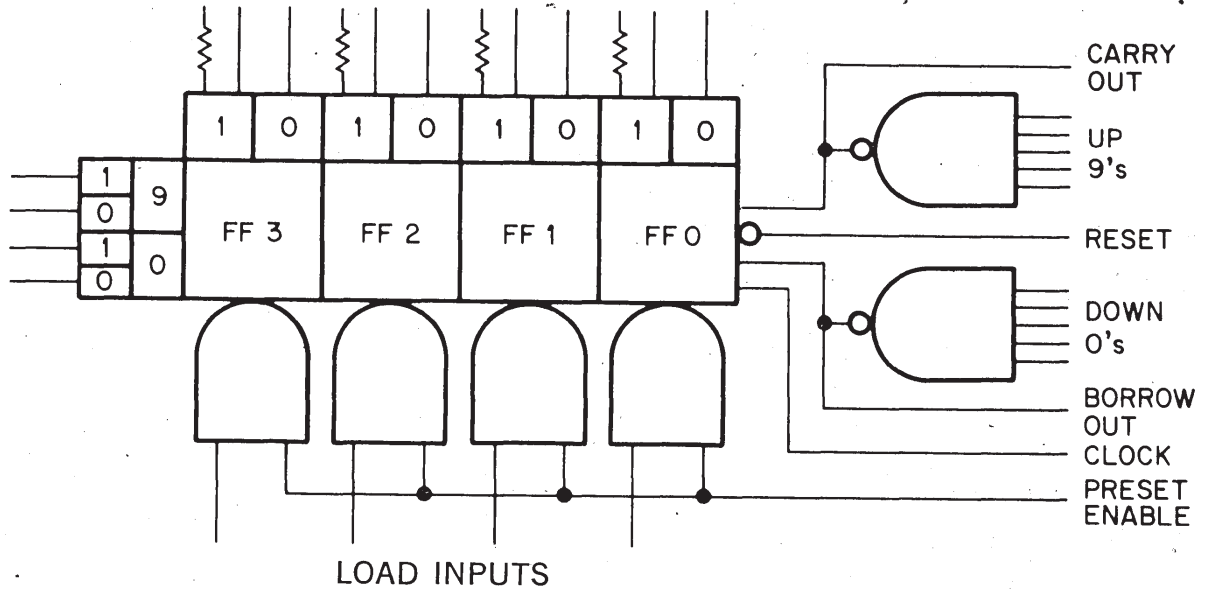


BCD UP/DOWN COUNTER M213

M SERIES



PIN	A CONNECTOR		B CONNECTOR	
	SIDE (1)	SIDE (2)	SIDE (1)	SIDE (2)
A	—	+5	—	+5
B	—	—	—	—
C	—	Ground	—	Ground
D	9 (0) Out	9 (1) Out	0 (0) Out	0 (1) Out
E	9 In	Up	0 In	Down
F	9 In	9 In	0 In	0 In
H	Carry Out	9 In	Borrow Out	0 In
J	Test Point	9 In	—	0 In
K	—	9 In	—	0 In
L	—	9 In	—	0 In
M	Test Point	Preset Enable	—	—
N	—	Clock	Test Point	Reset
P	Test Point	Load FF 0	Test Point	Load FF 2
R	Test Point	Load FF 1	Test Point	Load FF 3
S	FF 0 (0)	FF 0 (1)	FF 2 (0)	FF 2 (1)
T	Ground	FF 0 (1)	Ground	FF 2 (1)
U	FF 1 (0)	FF 1 (1)	FF 3 (0)	FF 3 (1)
V	—	FF 1 (1)	—	FF 3 (1)

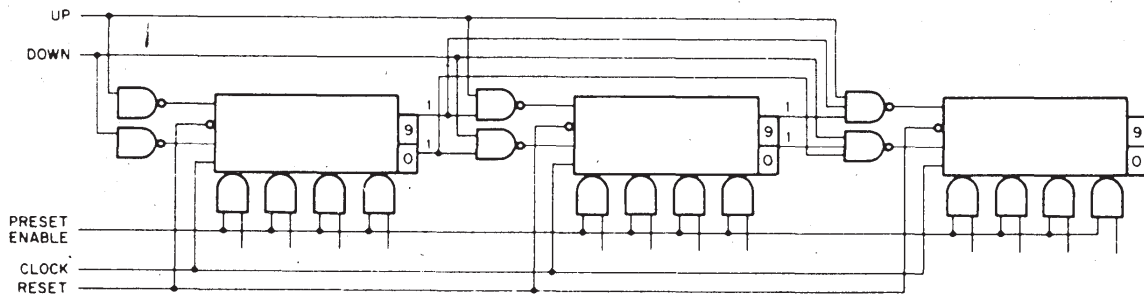
The M213 can be used to construct multi-digit synchronous counters for up/down counting in binary coded decimal. The maximum counting rate is 5 MHz. The counting direction is controlled by enabling the up or down control gate inputs. For maximum noise immunity, the up and down control lines should be kept low until counting is desired. Clock pulses that occur while the up and down lines are both low will not change the contents of the counter. Unpredictable operation will result if both the up and down lines are high at the same time. Positive clock pulses should not occur sooner than 50 ns after any change in the up or down control lines.

The "1" side of each flip-flop output is available directly for controlling nearby logic or through an isolation resistor when decoding displays are being driven at the end of long lines.

The counter may be preset by first resetting the counters and enabling the preset line. The clock input should then be pulsed once with a positive pulse to transfer data from the load inputs into the flip-flops. The up and down control lines must both be low for correct preset operation.

Counter Construction: The up and down input gate wiring for cascading M213 modules makes it possible to construct the hardware for fixed decimal point counters so that additional digits to the left or right of the decimal point can be added later as options. If the sockets are wired initially for a larger counter than is thought to be required, the unused high order digits may be left blank. Unused low order digit sockets should have pins AD2 and BD2 connected to +3 volts. When it is found that additional counter capacity or accuracy is needed, M213 modules can be plugged into the blank sockets on either side of the decimal point as required.

The diagram below shows how to connect three M213 counters for up/down counting. Notice that all the counters are clocked at the same time, but that a counter will not count unless the counters of lower significant digits all contain 9's for up counting or 0's for down counting. All unused module inputs should be connected to +3 volts.



Inputs: The input loads presented are:

CLOCK	—	Eight unit loads
RESET	—	Eight unit loads
PRESET ENABLE	—	Four unit loads
All other inputs	—	One unit load

Pulse widths required:

CLOCK	POSITIVE	> 20 nsec
RESET	NEGATIVE	> 25 nsec

Outputs: Output drive ability:

FLIP-FLOP 1 or 0	—	Seven unit loads
FLIP-FLOP 1 (Resistor)	—	Five unit loads
(Total load on a 1 output is 7 unit loads.)		
CARRY OUT	—	Eight unit loads
BORROW OUT	—	Eight unit loads

Cascade Outputs:

9 (1), 9 (0)	
0 (1), 0 (0)	Ten unit loads

Power: +5 volts at 160 ma. (max.)