



MMC 351

AUTO CLOCK

GENERAL DESCRIPTION

The MMC 351 is a metal gate CMOS integrated circuit that provides or controls all signals needed for a 3 $\frac{1}{2}$ -digit LED watch. The display format is 12 hours, with an AM/PM indicator. The circuit time base is a 32768 Hz crystal controlled oscillator. The time base frequency is successively divided to provide drive signals for a multiplexed 7-segment display. In order to drive the display, the watch requires a BCD-to-7 segment decoder (the MMC4511, for example). The device operates from a single 3V to 18V supply. The MMC351 is available in a 16-lead dual-in-line package.

FEATURES

- 32768 Hz crystal controlled oscillator
- wide supply voltage range: 3 to 18V
- low current consumption (3mA)
- 12 hours display format
- on-chip oscillator

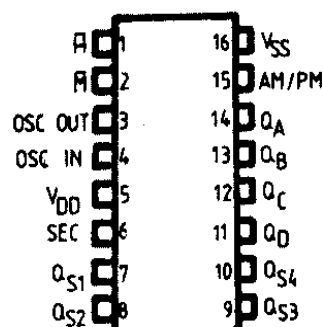
ABSOLUTE MAXIMUM RATINGS

V_{DD}	Supply voltage	-0.5 ...	18 V
V_I	Input voltage	-0.5 ...	$V_{DD} + 0.5$ V
P_D	Total power dissipation	200 mW	
T_A	Operating temperature	-40 ...	+ 85 °C
T_S	Storage temperature range	-65 ...	+ 155 °C

RECOMMENDED OPERATING CONDITIONS

V_{DD}	Supply voltage	3 ...	15 V
V_I	Input voltage	0 ...	V_{DD}
T_A	Operating temperature	-40 ...	+ 85 °C

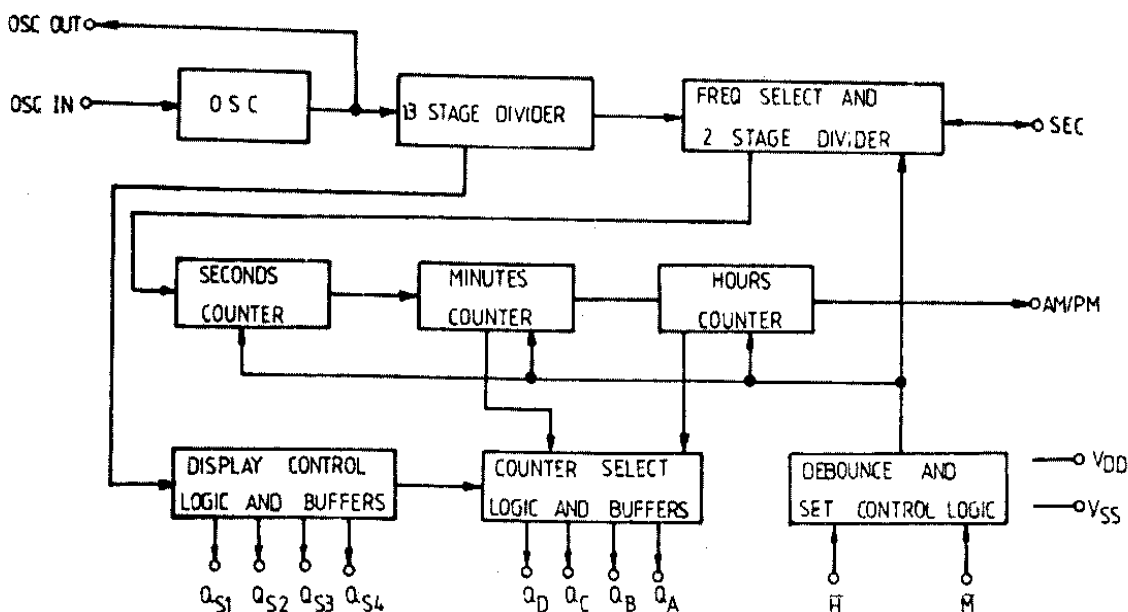
CONNECTION DIAGRAM



STATIC ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$, $f_{osc} = 32\,768\text{ Hz}$)

PARAMETER	TEST CONDITIONS				VALUES		UNIT
	V_I (V)	V_O (V)	I_O (μA)	V_{DD} (V)	25°C		
					min.	max.	
I_L Quiescent current	0/5 0/10 0/15			5 10 15		1400 1600 1800	μA
V_{OH} Output low voltage	0/5 0/10 0/15		<1 <1 <1	5 10 15	4.95 9.95 14.95		V
V_{OL} Output low voltage	5/0 10/0 15/0		<1 <1 <1	5 10 15		0.05 0.05 0.05	V
V_{IH} Input high voltage		0.5/4.5 1/9 1.5/13.5	<1 <1 <1	5 10 15	3.5 7 11		V
V_{IL} Input low voltage		4.5/0.5 9/1 13.5/1.5	<1 <1 <1	5 10 15		1.5 3.0 4.0	V
I_{IH} I_{IL} Input leakage current	0/15			15		± 0.3	μA
I_{OH} Drive current on BCD outputs	0/5 0/5 0/10 0/15	2.5 4.6 9.5 13.5		5 5 10 15		0.5 0.5 1.5 3.0	mA
I_{OL} Sink current on BCD outputs	0/5 0/10 0/15	0.4 0.5 1.5		5 10 15		0.5 1.5 3.0	mA
I_{OH} Drive current on digit outputs	0/5 0/5 0/10 0/15	2.5 4.6 9.5 13.5		5 5 10 15		0.5 0.5 1.5 3.0	mA
I_{OL} Sink current on digit outputs	0/5 0/10 0/15	0.4 0.5 1.5		5 10 15		0.14 0.5 0.9	mA
I_{OH} Drive current on AM/PM, SEC outputs	0/5 0/5 0/10 0/15	2.5 4.6 9.5 13.5		5 5 10 15		0.1 0.1 0.2 0.4	mA
I_{OL} Sink current on AM/PM, SEC outputs	0/5 0/10 0/15	0.4 0.5 1.5		5 10 15		0.1 0.2 0.4	mA
I_{OH} Drive current on OSC OUT outputs	0/5 0/5 0/10 0/15	2.5 4.6 9.5 13.5		5 5 10 15		0.5 0.5 1.5 3.0	mA
I_{OL} Sink current on OSC OUT outputs	0/5 0/10 0/15	0.4 0.5 1.5		5 10 15		0.5 1.5 3.0	mA
C_I Input capacitance	Any input					7.5	pF

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Time base:

The time base of the watch is provided by connecting a crystal controlled RC network to the on-chip CMOS inverter/amplifier.

Display multiplexing:

Outputs from each counter are time-division multiplexed to provide digit-sequential access to the time data. The 3 1/2 digits of the display are multiplexed with a 22% duty cycle, 1024 Hz signal.

Time display:

The hour information is displayed in digit positions 1 and 2, while minute information in digit positions 3 and 4. There are an AM/PM indicator and a seconds serially output.

Time setting:

Closure of the 'M' switch will advance minutes at a 2 Hz rate, with no advance of the hours counter and with seconds counter in 00. Closure of the 'H' switch will advance hours counter at a 1 Hz rate. When POWER ON, minutes counter must be set first.

TYPICAL APPLICATIONS

