

ICM7208

7-Digit LED Display Counter



T-45-23-29

ICM7208

GENERAL DESCRIPTION

The ICM7208 is a fully integrated seven decade counter-decoder-driver and is manufactured using Intersil's low voltage metal gate CMOS process.

Specifically the ICM7208 provides the following on chip functions: a 7 decade counter, multiplexer, 7 segment decoder, digit & segment driver, plus additional logic for display blanking, reset, input inhibit, and display on/off.

For unit counter applications the only additional components are a 7 digit common cathode display, 3 resistors and a capacitor to generate the multiplex frequency reference, and the control switches.

The ICM7208 is intended to operate over a supply voltage of 2 to 6 volts as a medium speed counter, or over a more restricted voltage range for high frequency applications.

As a frequency counter it is recommended that the ICM7208 be used in conjunction with the ICM7207 Oscillator Controller, which provides a stable HF oscillator, and output signal gating.

FEATURES

- Low Operating Power Dissipation <10mW
- Low Quiescent Power Dissipation <5mW
- Counts and Displays 7 Decades
- Wide Operating Supply Voltage Range $2V \leq V_{DD} \leq 6V$
- Drives Directly 7 Decade Multiplexed Common Cathode LED Display
- Internal Store Capability
- Internal Inhibit to Counter Input
- Test Speedup Point

ORDERING INFORMATION

Part Number	Temperature Range	Package
ICM7208PI	-25°C to +85°C	28 Lead Plastic DIP

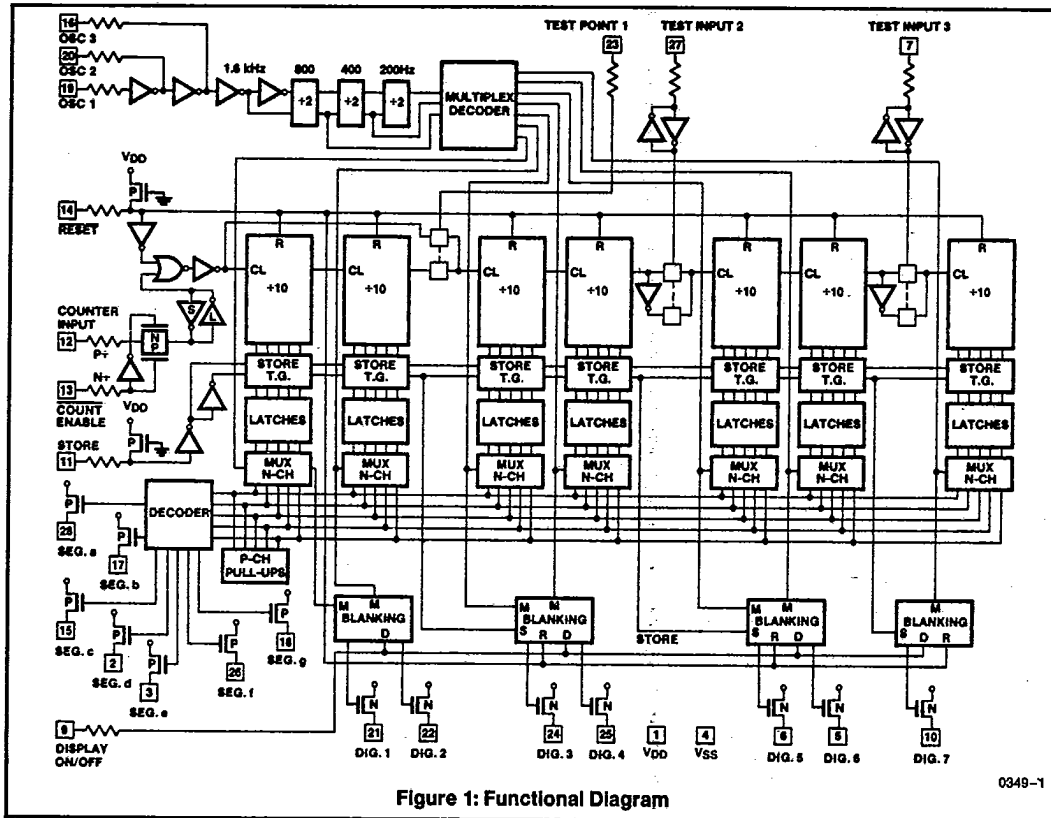


Figure 1: Functional Diagram

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NOTE: All typical values have been characterized but are not tested.

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ABSOLUTE MAXIMUM RATINGS

- Supply Voltage (Note 2) ($V_{DD}-V_{SS}$) 6V
- Input Voltage Range (any input terminal) (Note 2) $V_{SS}-0.3V$ to $V_{DD}+0.3V$
- Output Digit Drive Current (Note 3) 150mA
- Output Segment Drive Current 30mA
- Power Dissipation (Note 1) 1W
- Operating Temperature Range $-25^{\circ}C$ to $+85^{\circ}C$
- Storage Temperature Range $-65^{\circ}C$ to $+150^{\circ}C$
- Lead Temperature (Soldering, 10sec) $300^{\circ}C$

NOTE: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

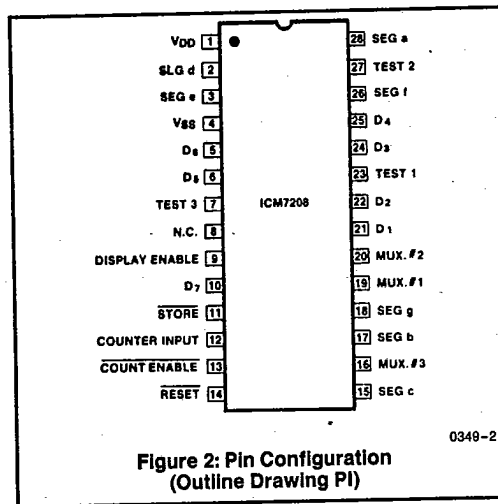


Figure 2: Pin Configuration (Outline Drawing PI)

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ELECTRICAL CHARACTERISTICS ($V_{DD}=5V$, $V_{SS}=0V$, $T_A=25^{\circ}C$, display off, unless otherwise specified)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
I_{Q1}	Quiescent Current	All controls plus terminal 19 connected to V_{DD} No multiplex oscillator		30	300	μA
I_{Q2}	Quiescent Current	All control inputs plus terminal 19 connected to V_{DD} except STORE which is connected to V_{SS}		70	350	
I_{DD1}	Operating Supply Current	All inputs connected to V_{DD} , RC multiplexer osc operating $f_{in} < 25kHz$		210	500	
I_{DD2}	Operating Supply Current	$f_{in} = 2MHz$			700	
V_{SUPPLY}	Supply Voltage Range	$f_{in} \leq 2MHz$	3.5		5.5	V
R_{DIG}	Digit Driver On Resistance			4	12	Ω
I_{DIG}	Digit Driver Leakage Current				500	μA
r_{SEG}	Segment Driver On Resistance			40		Ω
I_{SLK}	Segment Driver Leakage Current				500	μA
R_p	Pullup Resistance of RESET or STORE Inputs		100	400		k Ω
R_{IN}	COUNTER INPUT Resistance	Terminal 12 either at V_{DD} or V_{SS}			100	
V_{HIN}	COUNTER INPUT Hysteresis Voltage			25	50	mV

- NOTES:**
- This value of power dissipation refers to that of the package and will not be obtained under normal operating conditions.
 - The supply voltage must be applied before or at the same time as any input voltage. This poses no problems with a single power supply system. If a multiple power supply system is used, it is mandatory that the supply for the ICM7208 is switched on before the other supplies otherwise the device may be permanently damaged.
 - The output digit drive current must be limited to 150mA or less under steady state conditions. (Short term transients up to 250mA will not damage the device.) Therefore, depending upon the LED display and the supply voltage to be used it may be necessary to include additional segment series resistors to limit the digit currents.

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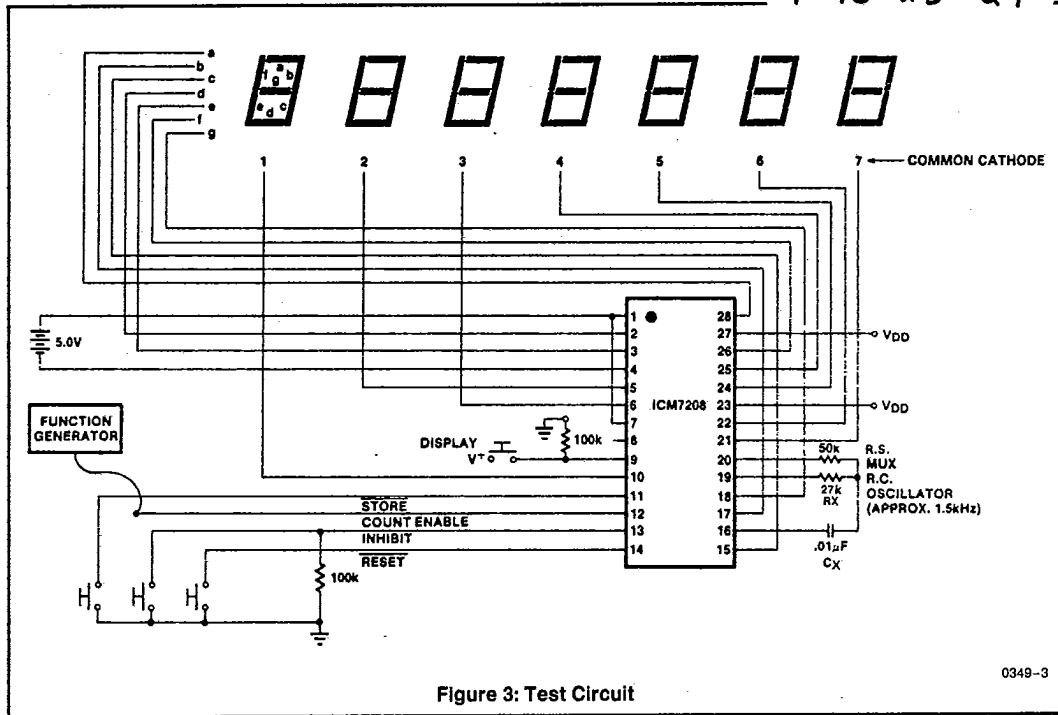
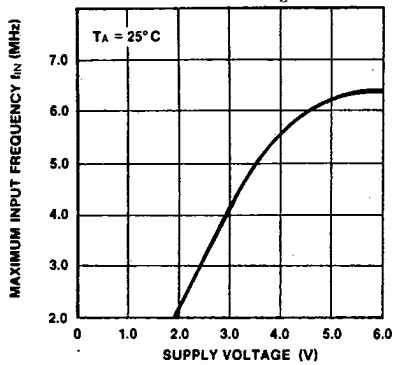


Figure 3: Test Circuit

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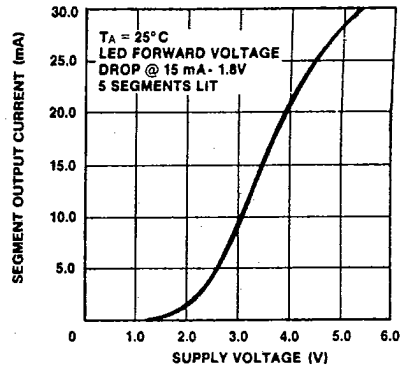
TYPICAL PERFORMANCE CHARACTERISTICS

MAXIMUM COUNTER INPUT FREQUENCY AS A FUNCTION OF SUPPLY VOLTAGE



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SEGMENT OUTPUT CURRENT AS A FUNCTION OF SUPPLY VOLTAGE



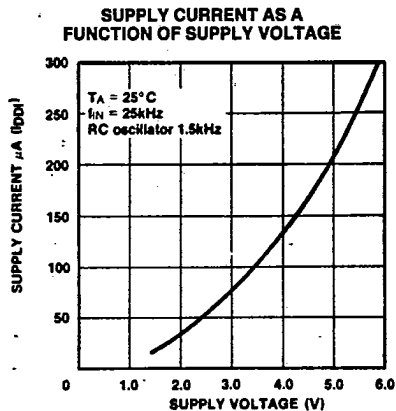
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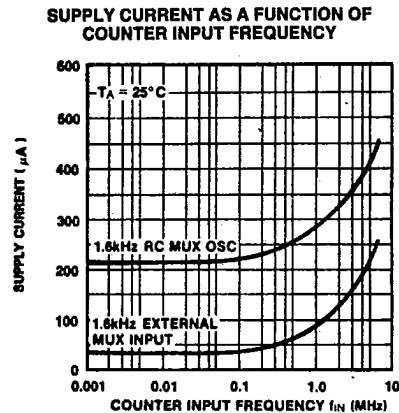
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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)


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TEST PROCEDURES

The ICM7208 is provided with three input terminals 7, 23, 27 which may be used to accelerate testing. The least two significant decade counters may be tested by applying an input to the 'COUNTER INPUT' terminal 12. 'TEST POINT' terminal 23 provides an input which bypasses the 2 least significant decade counters and permits an injection of a signal into the third decade counter. Similarly terminals 7 and 27 permit rapid counter advancing at two points further along the string of decade counters.

CONTROL INPUT DEFINITIONS

Input	Terminal	Voltage	Function
1. DISPLAY	9	V _{DD} V _{SS}	Display On Display Off
2. STORE	11	V _{DD} V _{SS}	Counter Information Latched Counter Information Transferring
3. ENABLE	13	V _{DD} V _{SS}	Input to Counter Blocked Normal Operation
4. RESET	14	V _{DD} V _{SS}	Normal Operation Counters Reset

COUNTER INPUT DEFINITION

The internal counters of the ICM7208 index on the negative edge of the input signal at terminal #12.

DETAILED DESCRIPTION
Format of Signal to be Counted

The noise immunity of the COUNTER INPUT Terminal is approximately $\frac{1}{3}$ the supply voltage. Consequently, the input signal should be at least 50% of the supply in peak to peak amplitude and preferably equal to the supply.

The optimum input signal is a 50% duty cycle square wave equal in amplitude to the supply. However, as long as the rate of change of voltage is not less than approximately 10^{-4} V/ μ s, at 50% of the power supply voltage, the input waveshape can be sinusoidal, triangular, etc.

When driving the input of the ICM7208 from TTL, a 1k-5k Ω pull-up resistor to the positive supply must be used to increase peak to peak input signal amplitude.

Display Considerations

Any common cathode multiplexable LED display may be used. However, if the peak digit current could exceed 150mA for any prolonged time, it is recommended that resistors be included in series with the segment outputs to limit digit current to 150mA.

The ICM7208 is specified with 500 μ A of possible digit leakage current. With certain new LED displays that are extremely efficient at low currents, it may be necessary to include resistors between the cathode outputs and the positive supply to bleed off this leakage current.

Display Multiplex Rate

The ICM7208 has approximately 0.5 μ s overlap between output drive signals. Therefore, if the multiplex rate is very fast, digit ghosting will occur. The ghosting determines the upper limit for the multiplex frequency. At very low multiplex rates flicker becomes visible.

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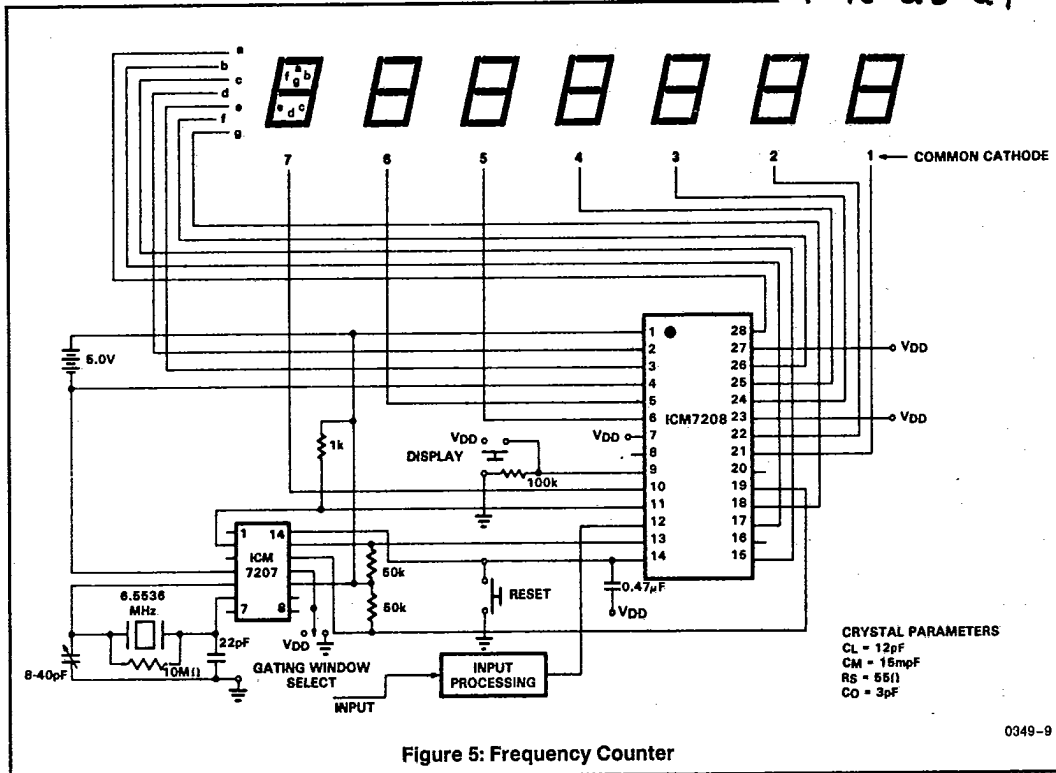


Figure 5: Frequency Counter

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Note: For a 1 sec count window which allows all 7 digits to be used with a resolution of 1Hz, the ICM7207 can be replaced with the ICM7207A. Circuit details are given on the 7207A data sheet.

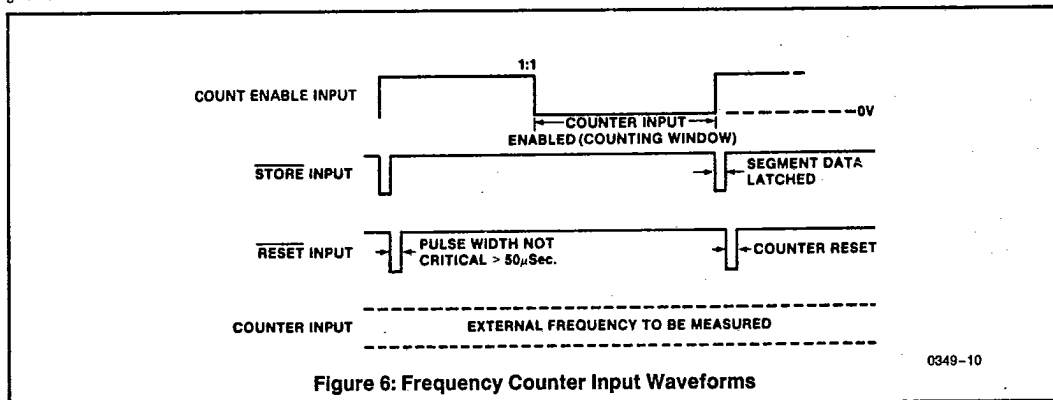


Figure 6: Frequency Counter Input Waveforms

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Period Counter

For this application, as opposed to the frequency counter, the gating and the input signal to be measured are reversed to the frequency counter. The input period is multiplied by two to produce a single polarity signal (50% duty cycle) equal to the input period, which is used to gate into the counter the frequency reference (1MHz in this case). Figure

8 shows a block schematic of the input waveform generator. The 1MHz frequency reference is generated by the ICM7209 Clock Generator using an 8MHz oscillator frequency and internally dividing this frequency by 8. Alternatively, a 1MHz signal could be applied directly to COUNTER INPUT. Waveforms are shown in Figure 7.

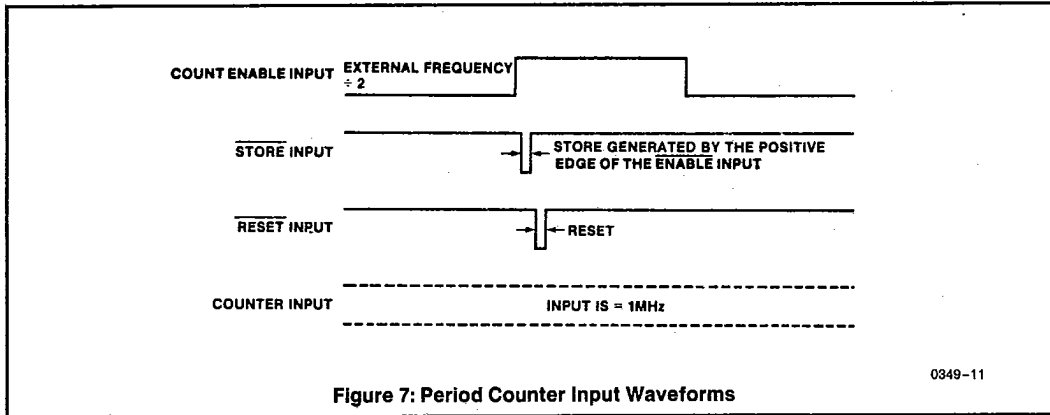


Figure 7: Period Counter Input Waveforms

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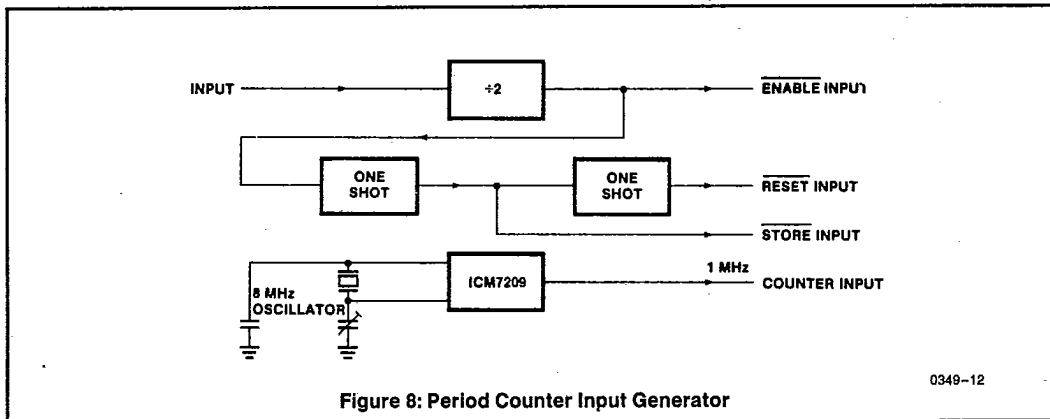


Figure 8: Period Counter Input Generator

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