



MM5450N/5450V/5451N/5451V

LED Display Driver *T-52-13-D7*

General Description

The MM5450 and MM5451 LED display drivers are monolithic MOS IC's fabricated in an N-Channel, metal-gate process. The technology produces low threshold, enhancement mode, and ion-implanted depletion mode devices. These devices are available in packaged or die form, suitable for conventional packaging, hybrid assembly or chip on board technology.

A single pin controls the LED display brightness by setting a reference current through a variable resistor connected to V_{DD}.

Features

- Continuous brightness control
- Serial data input
- No load signal requirement
- Enable (on MM5450)
- Wide power supply operation
- TTL compatibility
- 34 or 35 outputs, 15 mA capability
- Alphanumeric capability
- Available in die or packaged form

Applications

- Industrial control indicator
- Relay driver
- Digital clock, thermometer, counter, voltmeter
- Instrumentation readouts

Ordering Information

Part Number	Temp. Range	Package
MM5450N	-25 to +85°C	40-pin Plastic DIP
MM5451N	-25 to +85°C	40-pin Plastic DIP
MM5450V	-25 to +85°C	44-pin PLCC
MM5451V	-25 to +85°C	44-pin PLCC
MM5450/51 Die		none

Block Diagram

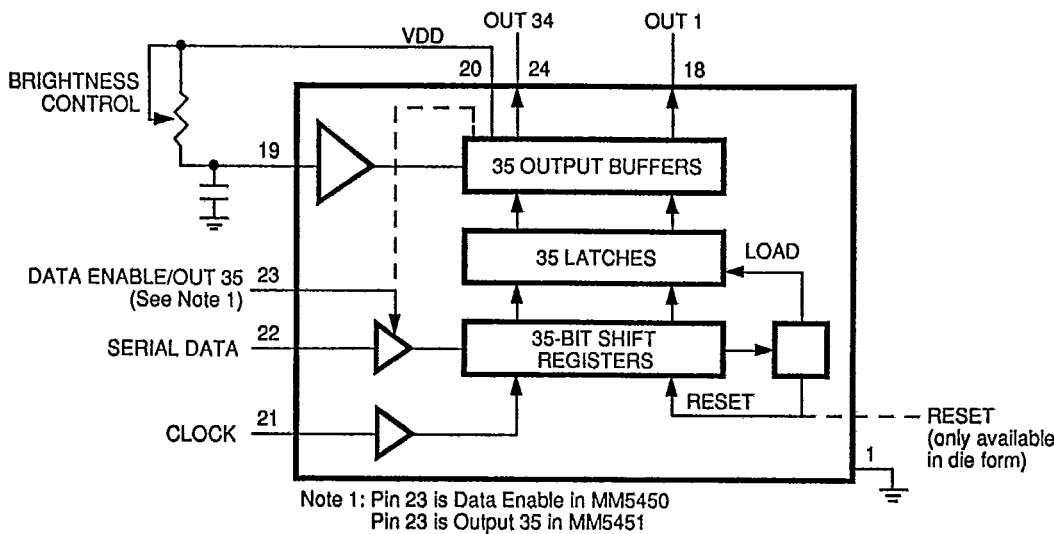
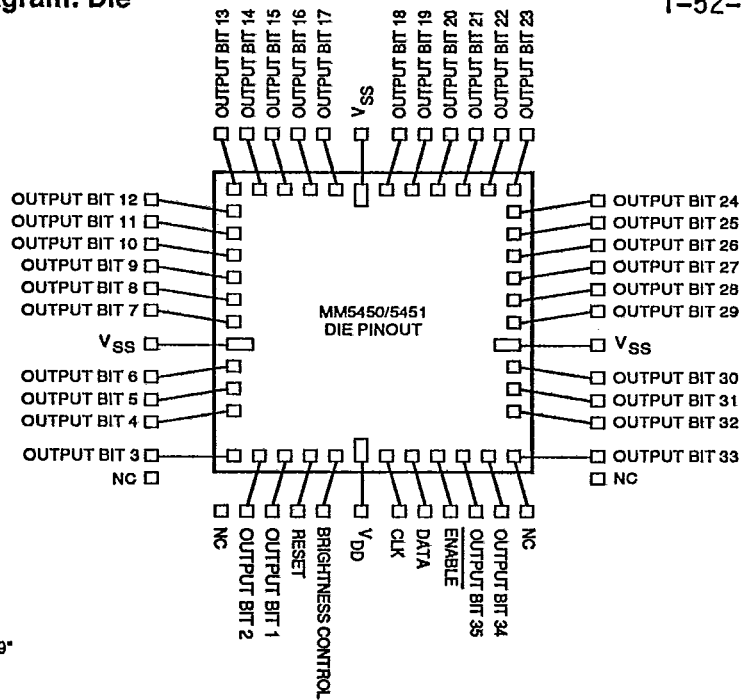


Figure 1.

Connection Diagram: Die

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Note: Die size is .106" x .99"

Figure 2.

Connection Diagram: Dual-in-line Package

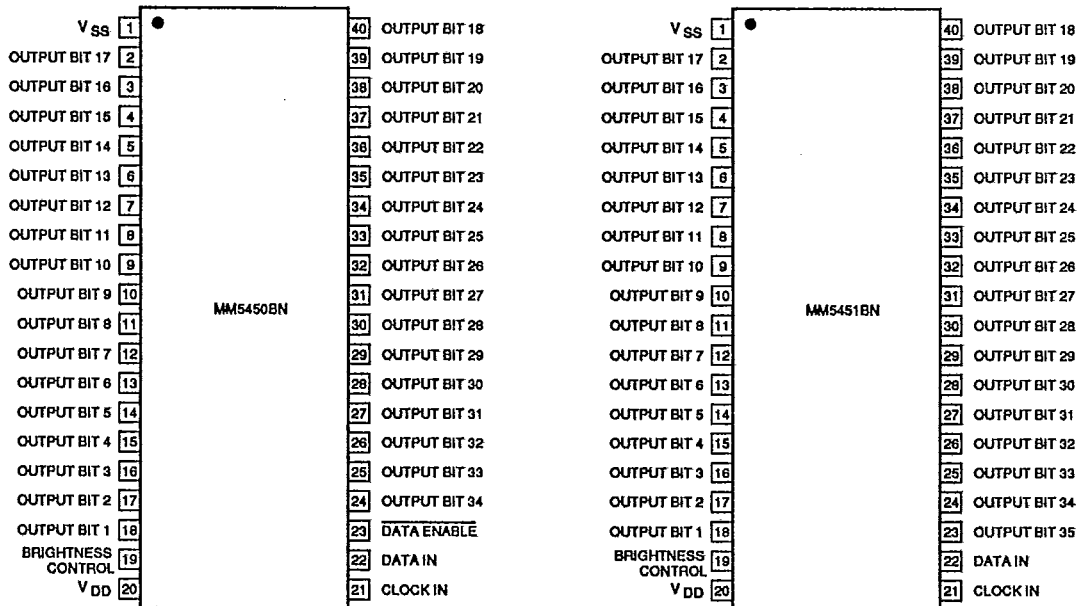


Figure 3a, 3b.

Connection Diagram: Plastic Leaded Chip Carrier

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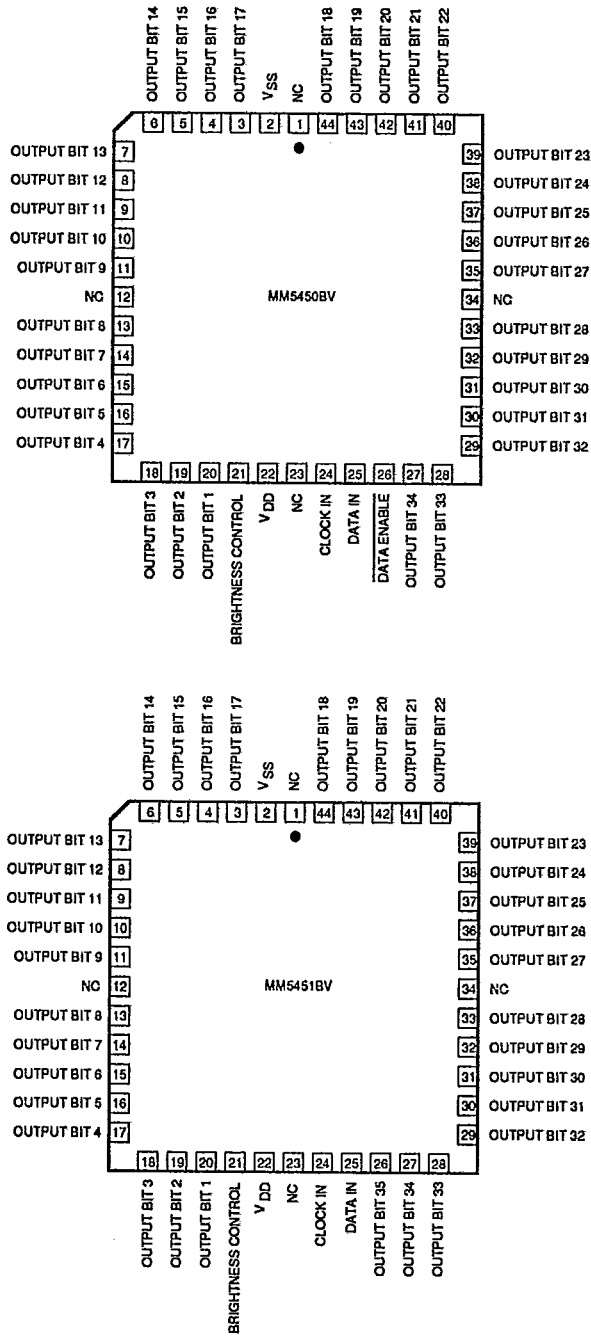


Figure 4a, 4b.

Functional Description

The MM5450 and MM5451 were designed to drive either 4 or 5 digit alphanumeric LED displays with the added benefit of requiring minimal interface with the display or data source.

Data is transferred serially via 2 signals; clock and serial data. Data transfer without the added inconvenience of an external load signal is accomplished by using a format of a leading "1" followed by the allowed 35 data bits. These 35 data bits are latched after the 36th has been transferred. This scheme provides non multiplexed, direct drive to the LED display. Characters currently displayed (thus, data output) changes only if the serial data bits differ from those previously transferred.

Control of the output current for LED displays provides for the display brightness. To prevent oscillations, a 1nF capacitor should be connected to pin 19, brightness control.

The block diagram is shown in Figure 1. For the MIC5450, the DATA ENABLE is a metal option and is used instead of the 35th output. The output current is typically 20 times greater than the current into pin 19, which is set by an external variable resistor. There is an external reset connection shown which is available on unpackaged (die) units only.

Figure 2 illustrates the die "pinout", or pad location for bonding in "chip on board" applications.

Figure 5 shows the input data format. A leading "1" is followed by 35 bits of data. After the 36th had been transferred, a LOAD signal is generated synchronously with the clock high state. This loads the 35 bits of data into the latches. The low side of the clock is used to generate a RESET signal which clears all shift registers for the next set of data. All shift registers are static master-slave, with no clear for the master portion of the first register, allowing continuous operation.

There must be a complete set of 36 clocks or the shift registers will not clear.

When the chip first powers ON an internal power ON reset signal is generated which resets all registers and all latches. The START bit and the first clock return the chip to its normal operation.

Figure 3 and 4 show the pin-out of the MIC5450 and MIC5451. Bit 1 is the first bit following the start bit and it will appear on pin 18. A logical "1" at the input will turn on the appropriate LED.

Figure 5 shows the timing relationships between data, clock and DATA ENABLE. A max clock frequency of 0.5 MHz is assumed.

For applications where a lesser number of outputs are used, it is possible to either increase the current per output, or operate the part at higher than 1V V_{OUT} . The following equation can be used for calculations.

$$T_j = (V_{OUT}) (I_{LED}) (\text{No. of segments}) (124^\circ\text{C/W}) + T_A$$

where:

T_j = junction temperature + 150°C max

V_{OUT} = the voltage at the LED driver outputs

I_{LED} = the LED current

124°C/W = thermal resistance of the package

T_A = ambient temperature

The above equation was used to plot Figures 7-9.

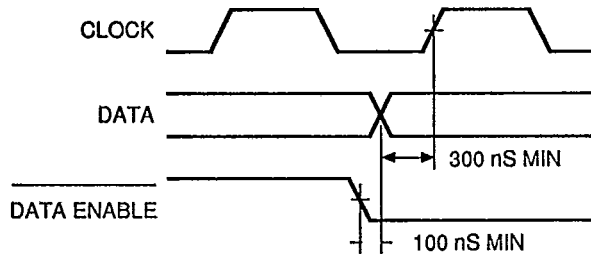


Figure 5.

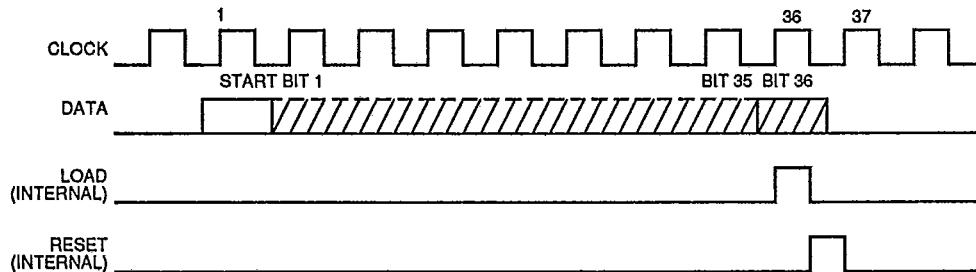


Figure 6. Input Data Format

Absolute Maximum Ratings

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Voltage at Any Pin	V_{SS} to $V_{SS}+12V$	Junction Temperature	+150°C
Operating Temperature	-25°C to +85°C	Lead Temperature	300°C
Storage Temperature	-65°C to +150°C	(max. soldering time is 10 seconds)	
Power Dissipation	560 mW at +85°C 1 mW at +25°C		

Electrical Characteristics

T_A within operating range, $V_{DD} = 4.5 V$ to $11.0 V$, $V_{SS} = 0 V$ unless otherwise specified

Parameter	Conditions	Min	Typ	Max	Units
Power Supply		4.75		11	V
Power Supply Current	Excluding Output Loads			7	mA
Input Voltages					
Logical "0" Level (V_L)	$\pm 10 \mu A$ Input Bias	-0.3		0.8	V
Logical "1" Level (V_H)	$4.75 \leq V_{DD} \leq 5.25$	2.2		V_{DD}	V
	$V_{DD} > 5.25$	$V_{DD} - 2$		V_{DD}	V
Brightness Input (Note 2)		0		0.75	mA
Output Sink Current					
Segment OFF	$V_{OUT} = 3.0 V$			10	μA
Segment ON	$V_{OUT} = 1.0 V$ (Note 3)	0		15	mA
	Brightness Input = 0 μA	0		10	μA
	Brightness Input = 100 μA	2.0	2.7	4	mA
	Brightness Input = 740 μA	15		25	mA
Brightness Input Voltage (Pin 19)	Input Current = 750 μA	3.0		4.3	V
Output Matching (Note 1)				± 20	%
Clock input	(Notes 5 and 6)				
Frequency, f_C				500	kHz
High Time, t_H		950			nS
Low Time, t_L		950			nS
Data Input					
Set-Up Time, t_{DS}		300			nS
Hold Time, t_{DH}		300			nS
Data Enable Input Set-up Time, t_{DES}		100			nS
Reset Pad Current (Die Version)		8			μA



Note 1: Output matching is calculated as the percent variation $(I_{MAX} + I_{MIN}) / 2$.

Note 2: With a fixed resistor on the brightness input pin, some variation in brightness will occur from one device to another. Maximum brightness input current can be 2 mA as long as Note 3 and junction temperature equation are complied with.

Note 3: See Figures 7, 8 and 9 for Recommended Operating Conditions and limits. Absolute maximum for each output should be limited to 40 mA.

Note 4: The V_{OUT} voltage should be regulated by the user. See Figures 8 and 9 for allowable V_{OUT} vs. I_{OUT} operation.

Note 5: AC input waveform specification for test purpose: $t_r \leq 20$ nS, $t_f \leq 20$ nS, $f = 500$ kHz, 50% $\pm 10\%$ duty cycle.

Note 6: Clock input rise and fall times must not exceed 300 nS.

Typical Performance Characteristics

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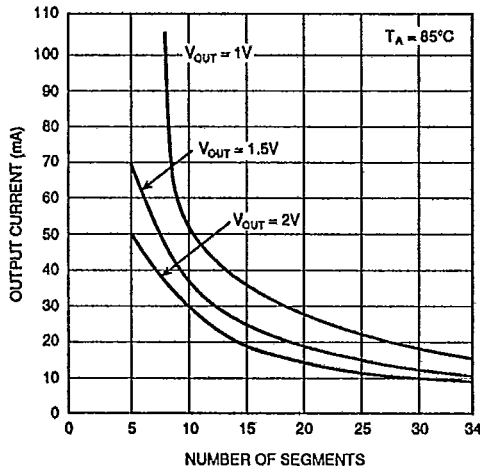


Figure 7.

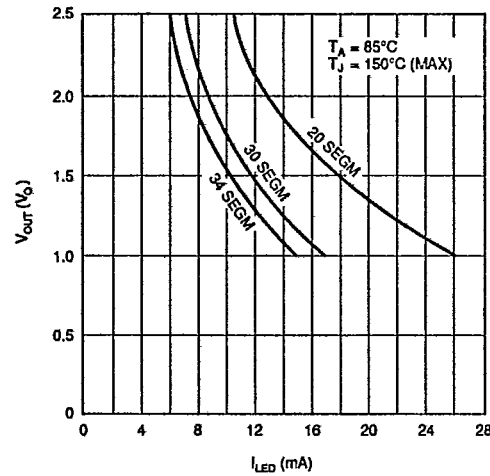


Figure 8.

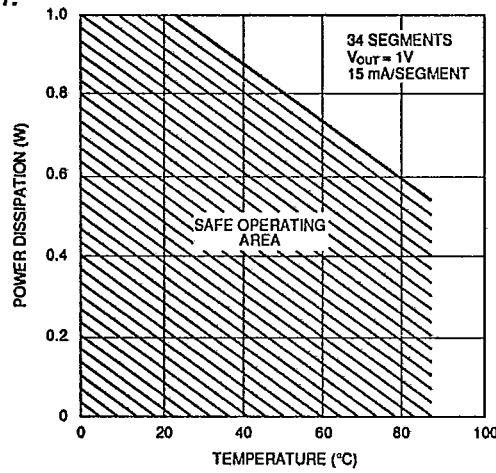


Figure 9.

Typical Applications

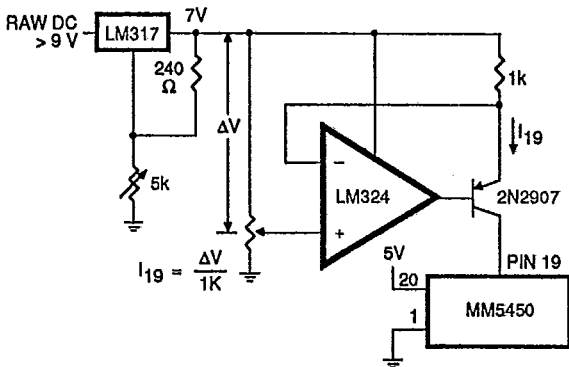


Figure 10. Typical Application of Constant Current Brightness Control

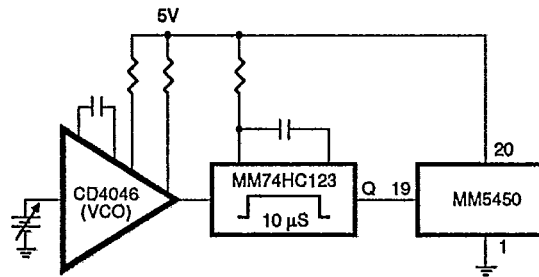


Figure 11. Brightness Control Varying the Duty Cycle

Typical Applications

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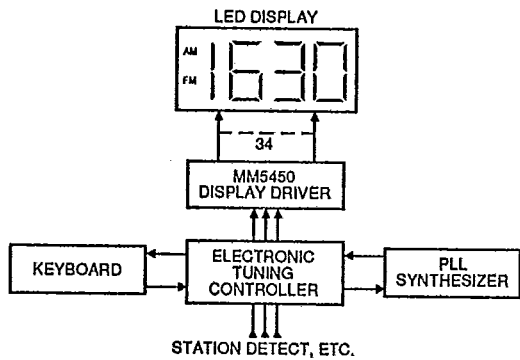


Figure 12. Basic Electronically Tuned Radio System

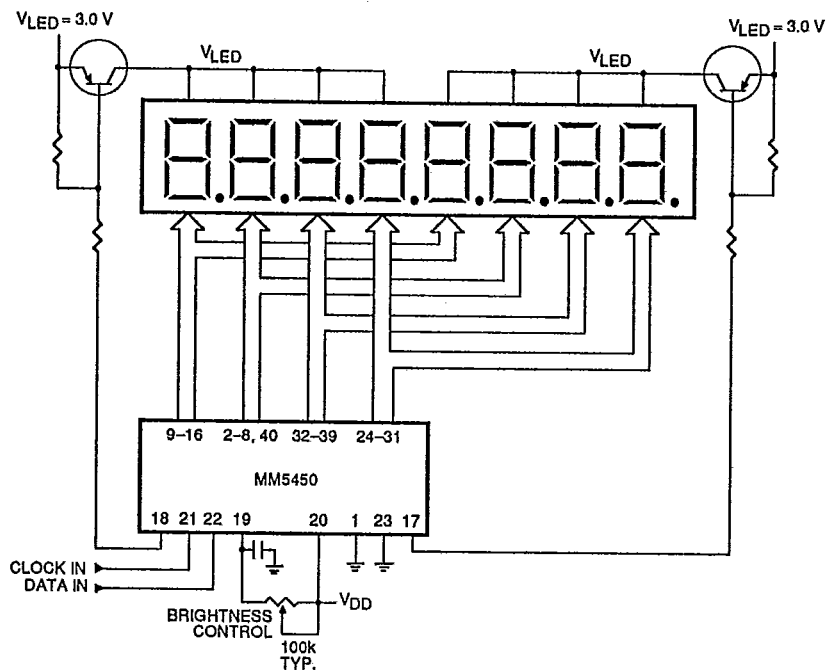


Figure 13. Duplexing 8 Digits with One MM5450.