National Semiconductor

MM5480 LED Display Driver

General Description

The MM5480 is a monolithic MOS integrated circuit utilizing N-channel metal gate low threshold, enhancement mode and ion-implanted depletion mode devices. It utilizes the MM5451 die packaged in a 28-pin package making it ideal for a 3½ digit display. The MM5480 is designed to drive common anode-separate cathode LED displays. A single pin controls the LED display brightness by setting a reference current through a variable resistor connected either to V_{DD} or to a separate supply of 11V maximum.

Features

- Continuous brightness control
- Serial data input
- No load signal required
- Wide power supply operation
- TTL compatibility
- Alphanumeric capability
- 3½ digit displays

Applications

- COPS™ microcontrollers or microprocessor displays
- Industrial control indicator
- Relay driver
- Digital clock, thermometer, counter, voltmeter
- Instrumentation readouts

Block Diagram

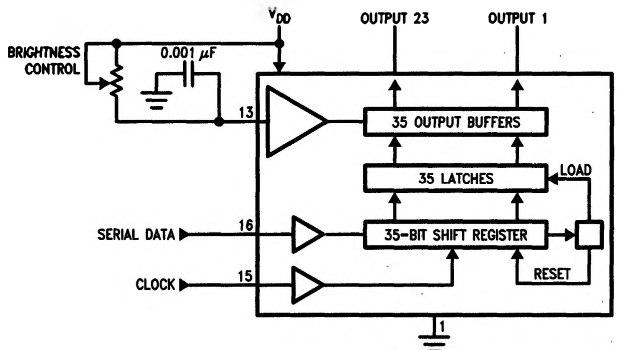

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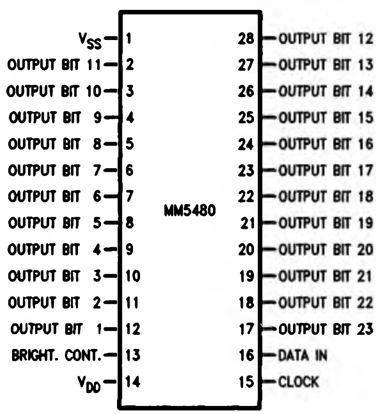
FIGURE 1

Connection Diagram

Dual-In-Line Package



Order Number MM5480N
See NS Package Number N28B

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Top View
FIGURE 2

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Voltage at Any Pin	V_{SS} − 0.3V to V_{SS} + 12V
Storage Temperature	−65°C to +150°C
Power Dissipation at 25°C	
Molded DIP Package, Board Mount	2.4W*
Molded DIP Package, Socket Mount	2.1W**
Junction Temperature	150°C
Lead Temperature (Soldering, 10 sec.)	300°C

*Molded DIP Package, Board Mount, θ_{JA} = 52°C/W, Derate 19.2 mW/°C above 25°C.

**Molded DIP Package, Socket Mount, θ_{JA} = 58°C/W, Derate 17.2 mW/°C above 25°C.

Electrical Characteristics

T_A = −25°C to +85°C, V_{DD} = 4.75V to 11.0V, V_{SS} = 0V unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Power Supply		4.75		11	V
I_{DD}	Power Supply Current	Excluding Output Loads			7	mA
V_{IL}	Input Voltage Logical "0" Level	±10 μA Input Bias	−0.3		0.8	V
V_{IH}	Input Voltage Logical "1" Level	4.75V ≤ V_{DD} ≤ 5.25V	2.2		V_{DD}	V
		V_{DD} > 5.25V	V_{DD} − 2		V_{DD}	V
I_{BR}	Brightness Input Current (Note 2)		0		0.75	mA
I_{OH}	Output Sink Current (Note 3) Segment OFF	V_{OUT} = 3.0V			10.0	μA
I_{OL}	Output Sink Current (Note 3) Segment ON	V_{OUT} = 1V				
		Brightness Input = 0 μA	0		10.0	μA
		Brightness Input = 100 μA	2.0	2.7	4.0	mA
		Brightness Input = 750 μA	15.0		25.0	mA
V_{IBR}	Brightness Input Voltage (Pin 13)	Input Current = 750 μA	3.0		4.3	V
OM	Output Matching (Note 1)				±20	%

AC Electrical Characteristics T_A = −25°C to +85°C, V_{DD} = 5V ±0.5V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
f_C	Clock Input Frequency	(Notes 5 and 6)	DC		500	kHz
t_h	High Time		950			ns
t_l	Low Time		950			ns
t_{DS}	Data Input Set-Up Time		300			ns
t_{DH}	Data Input Hold Time		300			ns

Note 1: Output matching is calculated as the percent variation from (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: Absolute maximum for each output should be limited to 40 mA.

Note 4: The V_{OUT} voltage should be regulated by the user.

Note 5: AC input waveform specification for test purpose: t_r ≤ 20 ns, t_f ≤ 20 ns, f = 500 kHz, 50% ±10% duty cycle.

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

Functional Description

The MM5480 is specifically designed to operate 3½-digit alphanumeric displays with minimal interface with the display and the data source. Serial data transfer from the data source to the display driver is accomplished with 2 signals, serial data and clock. Using a format of a leading "1" followed by the 35 data bits allows data transfer without an additional load signal. The 35 data bits are latched after the 36th bit is complete, thus providing non-multiplexed, direct drive to the display. Outputs change only if the serial data bits differ from the previous time. Display brightness is determined by control of the output current for LED displays. A 0.001 μF ceramic or mica disc capacitor should be connected to brightness control, pin 13, to prevent possible oscillations.

A block diagram is shown in *Figure 1*. The output current is typically 20 times greater than the current into pin 13, which is set by an external variable resistor. There is an internal limiting resistor of 400Ω nominal value.

Figure 4 shows the input data format. A start bit of logical "1" precedes the 35 bits of data. At the 36th clock a LOAD signal is generated synchronously with the high state of the clock, which loads the 35 bits of the shift registers into the latches. At the low state of the clock a RESET signal is generated which clears all the shift registers for the next set of data. The shift registers are static master-slave configuration. There is no clear for the master portion of the first shift register, thus 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 5 shows the Output Data Format for the 5480. Because it uses only 23 of the possible 35 outputs, 12 of the bits are 'Don't Cares'.

Figure 3 shows the timing relationships between data and clock. A maximum 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.

$$T_j = (V_{OUT})(I_{LED})(\text{No. of segments})(\theta_{JA}) + T_A$$

where:

T_j = junction temperature, 150°C max.

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

I_{LED} = the LED current

θ_{JA} = thermal coefficient of the package

T_A = ambient temperature

θ_{JA} (Socket Mount) = 58°C/W

θ_{JA} (Board Mount) = 52°C/W

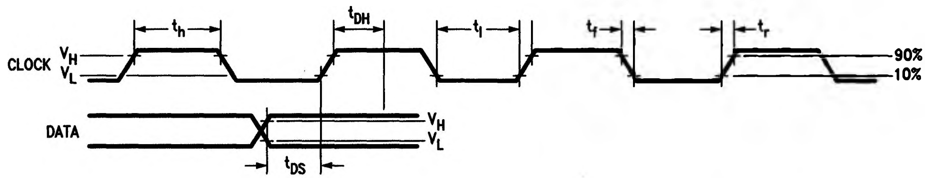

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FIGURE 3

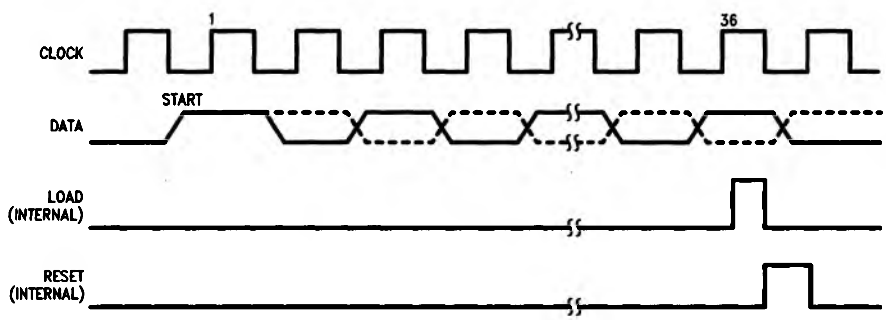

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FIGURE 4. Input Data Format

START	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	5451
START	X	1	2	3	4	5	6	7	X	X	X	8	9	10	11	X	X	X	X	12	13	14	15	16	17	X	18	X	X	19	20	21	22	23	X	5480

FIGURE 5. Output Data Format

Functional Description (Continued)

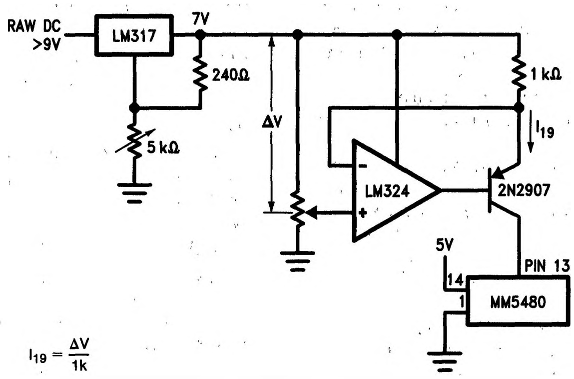

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FIGURE 6. Typical Application of Constant Current Brightness Control

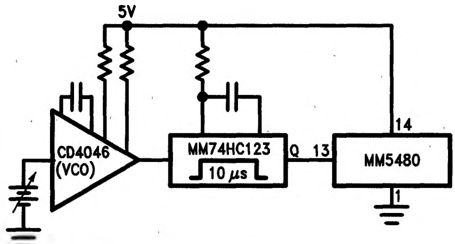

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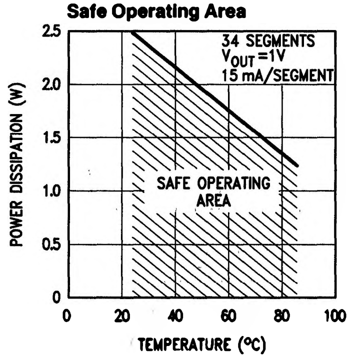
FIGURE 7. Brightness Control Varying the Duty Cycle

Safe Operating Area



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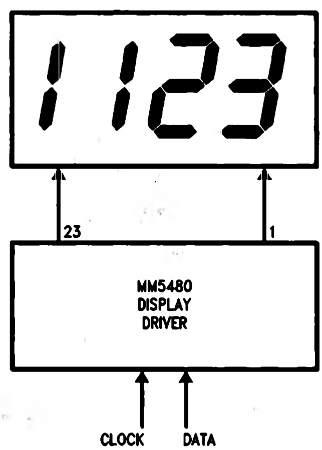
Basic 3½-Digit Interface



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