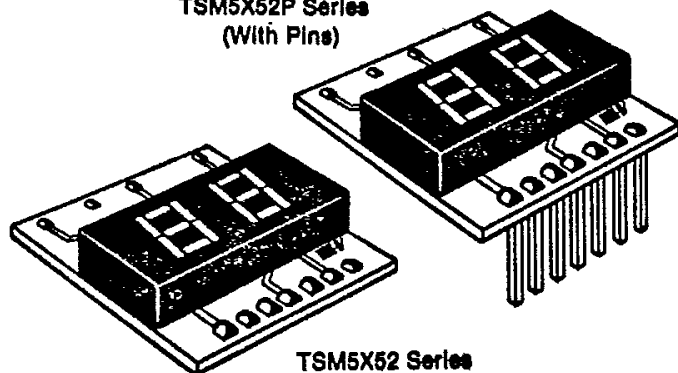




THREE-FIVE SYSTEMS, INC.

# NUMERIC INTEGRATED DISPLAY

TSM5052 (Red),  
TSM5252 (Green) &  
TSM5752 (High Efficiency Red)

TSM5X52P Series  
(With Pins)

TSM5X52 Series

## FEATURES

- Two 0.5" Digits
- LED Current Is Pre-set
- Serial Data Input
- Chip Enable
- TTL Compatible
- Direct Current Drive (Non-multiplexed)
- No External Capacitor or Resistor Required

## ABSOLUTE MAXIMUM RATINGS

$V_{DD}$ : 12V  
 $V_{LED}$ : Figure 2  
 Voltage at Any Other Pin: -0.3V to 12V  
 Driver Chip  
 Power Dissipation: 600mW Max.  
 Operating Temperature: -20°C to 70°C  
 Storage Temperature: -20°C to 70°C  
 Lead Soldering Time  
 @ 230°C: 5 sec. Max.

## APPLICATIONS

- Microprocessor Controlled Display
- Digital Clock, Thermometer
- Instrument Readouts, Counter
- Voltmeter
- Channel Indicator

## BLOCK DIAGRAM

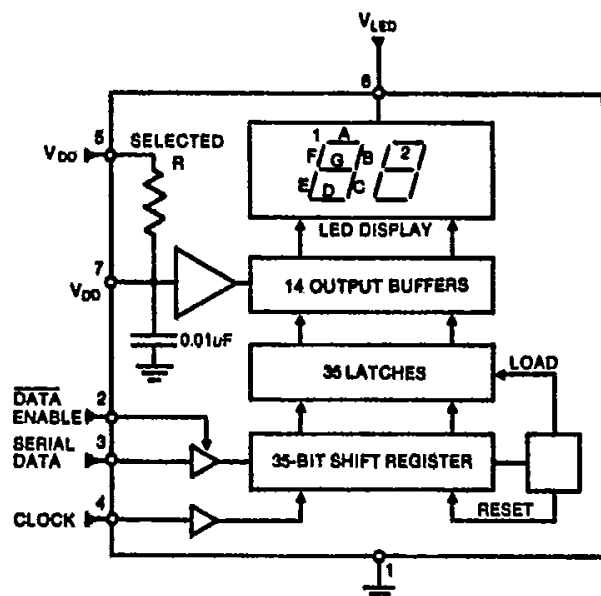


FIGURE 1—Block Diagram

## DESCRIPTION

The TSM5X52 Series are 2-digit, 0.5" height LED displays with an on-board serial data input/parallel data-out LED driver designed to operate with minimal interface to the data source. Current drive to the LEDs is pre-set.

Serial data transfer from the data source to the display driver is accomplished with three signals: data input, data enable, and clock. The data format consists of a leading "1" followed by 35 data bits. This 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.



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# NUMERIC INTEGRATED DISPLAY

## TSM5052, TSM5252 & TSM5752

### ELECTRICAL CHARACTERISTICS

| Symbol           | Parameter                               | Conditions (TA = 25°C)                           | Min. | Typ. | Max. | Units |
|------------------|---|--|------|------|------|-------|
| I <sub>DD</sub>  | V <sub>DD</sub> Supply Current          | V <sub>DD</sub> = 11V                            |      |      | 7.0  | mA    |
| I <sub>LED</sub> | V <sub>LED</sub> Supply Current/Segment | I <sub>BR</sub> = 400μA, V <sub>LED</sub> = 3.5V |      | 10   |      | mA    |
| V <sub>L</sub>   | Input Voltage "0" Level                 |  | -0.3 |      | 0.8  | V     |
| V <sub>H</sub>   | Input Voltage "1" Level                 |  | 2.2  |      | 12   | V     |
| I <sub>BR</sub>  | Brightness Input Current                |  | 0    |      | 600  | μA    |
| V <sub>IN</sub>  | Brightness Input Voltage                | I <sub>BR CONT</sub> = 600μA                     | 3.0  |      | 4.3  | V     |
| C <sub>F</sub>   | Input Clock Frequency                   |  |      |      | 0.5  | MHz   |
|                  | Duty Cycle                              |  | 40   | 50   | 60   | %     |

### OPTICAL CHARACTERISTICS

| Symbol         | Parameter             | Conditions (TA = 25°C)                                | Min. | Typ. | Max. | Units |
|----------------|-----------------------|---|------|------|------|-------|
| I <sub>L</sub> | LED Segment Intensity | I <sub>BR CONT</sub> = 400μA, V <sub>LED</sub> = 3.5V |      |      |      | mcd   |
|                | Red                   |   | 0.1  | 0.2  |      | mcd   |
|                | High Efficiency Red   |   | 0.5  | 0.8  |      | mcd   |
|                | Green                 |   | 0.6  | 1.5  |      | mcd   |
| λP             | Intensity Matching    | I <sub>BR CONT</sub> = 400μA, V <sub>LED</sub> = 3.5V |      |      | ±33  | %     |
|                | Peak Wavelength       | V <sub>DD</sub> = 5.0V, V <sub>LED</sub> = 3.5V       |      |      |      | nm    |
|                | Red                   |   |      | 655  |      | nm    |
|                | High Efficiency Red   |   |      | 635  |      | nm    |
|                | Green                 |   |      | 565  |      | nm    |

Note 1: Driver dissipation is given by P<sub>DR</sub> = (V<sub>LED</sub> - 1.7V) I<sub>L</sub> (Total) + (V<sub>DD</sub> - 7.0mA) I<sub>L</sub> where V<sub>LED</sub> is the LED supply Voltage, 1.7V is the minimum LED voltage drop and 7.0mA is the maximum current of the V<sub>DD</sub> supply. For standard (655nm) red, use 1.6V as minimum LED voltage.

Note 2: Unless otherwise stated, all specifications apply with the following conditions: V<sub>DD</sub> (supply) 4.75 to 11V, V<sub>LED</sub> (supply) 3.5V.

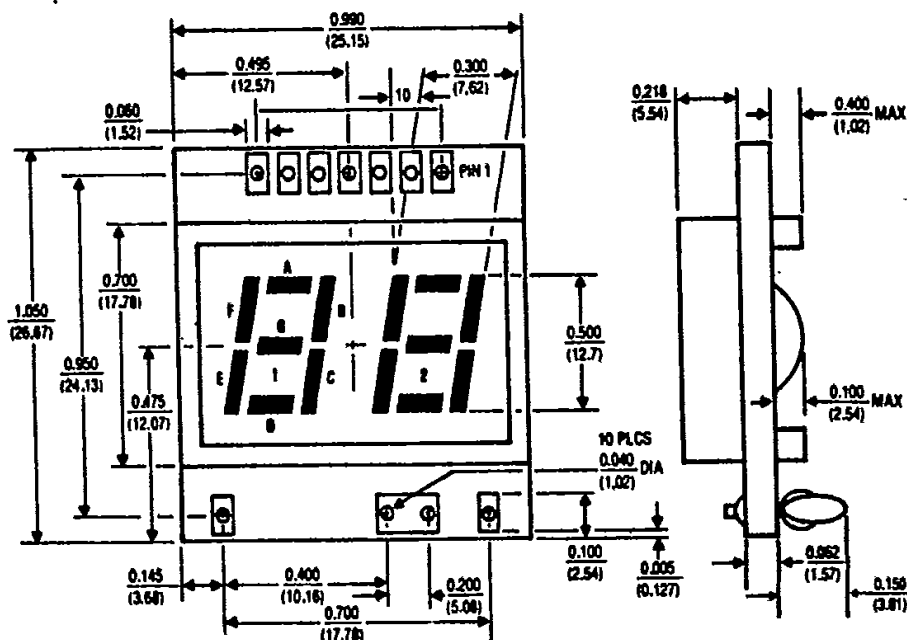
Note 3: The brightness input is connected to V<sub>DD</sub> with a resistor of the "Resistor Value" that is marked on the individual part.

### PHYSICAL DIMENSIONS

|     |                  |
|-----|------------------|
| PIN | FUNCTION         |
| 1   | GROUND           |
| 2   | ENABLE           |
| 3   | DATA             |
| 4   | CLOCK            |
| 5   | V <sub>DD</sub>  |
| 6   | V <sub>LED</sub> |
| 7   | V <sub>DD</sub>  |

DIMENSIONS: INCHES  
(Millimeters)

TOLERANCES: 0.XXX ± 0.015  
(X.XX ± 0.38)



"P" or "T" suffix for pins on PC board. Pins are 0.63" (16.00mm) beyond bottom of board x 0.025" (0.64mm) square.



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# NUMERIC INTEGRATED DISPLAY TSM5052, TSM5252 & TSM5752

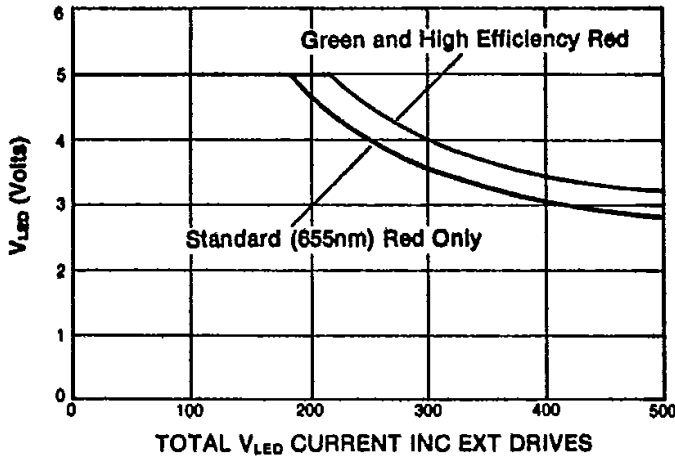


FIGURE 2—Max  $V_{LED}$  vs  $I_{LED}$  Circuit Per Figure 1

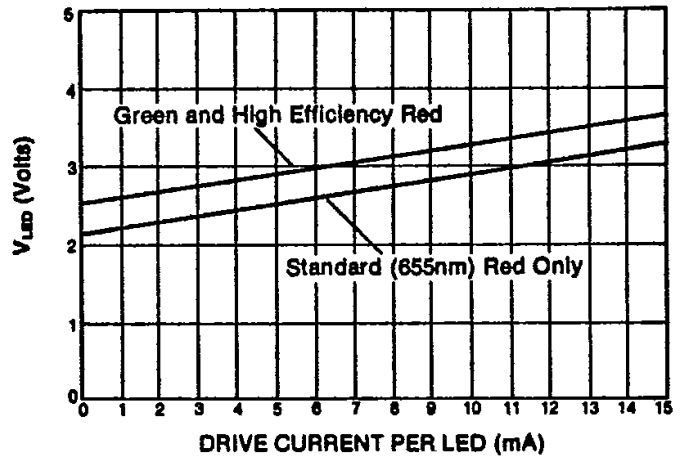


FIGURE 3—Min  $V_{LED}$  vs Drive Current Per LED

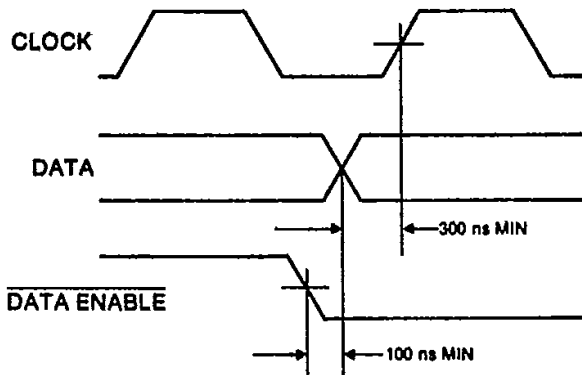


FIGURE 4—Timing Relationships

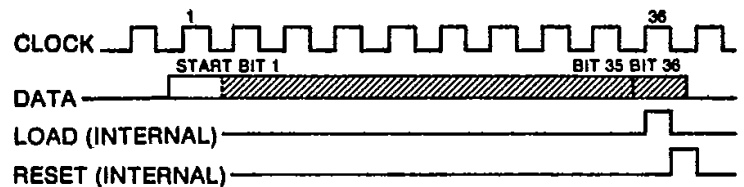


FIGURE 5—Input Data Format

## FUNCTION DESCRIPTION

A block diagram is shown in Figure 1, and Figures 4 and 5 show the timing relationships and input data format. The start bit precedes the 35 data bits. At the 36th clock, a LOAD signal is generated synchronously with the high state of the clock, which loads the 35 bits in 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 configurations. There is no clear for the master portion of the first shift register, thus allowing continuous operation.

If the clock is not continuous, there must be a complete set of 36 clocks, otherwise the shift registers will

not clear.

When the chips 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. To clear the display, load a "1" followed by 35 "0". This blanks the LED and resets the driver IC.

Bit 1 is the first bit following the start bit and determines the drive current state of segment A of digit 1 (note: segment and digit designations are given in the block diagram of Figure 1). The bit sequence for all segments is shown in Table 1.



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# NUMERIC INTEGRATED DISPLAY

## TSM5052, TSM5252 & TSM5752



| BIT | FUNCTION          | BIT | FUNCTION |
|-----|-------------------|-----|----------|
| 1   | Digit 1 Segment A | 18  | Not Used |
| 2   | Digit 1 Segment B | 19  | Not Used |
| 3   | Digit 1 Segment C | 20  | Not Used |
| 4   | Digit 1 Segment D | 21  | Not Used |
| 5   | Digit 1 Segment E | 22  | Not Used |
| 6   | Digit 1 Segment F | 23  | Not Used |
| 7   | Digit 1 Segment G | 24  | Not Used |
| 8   | Not Used          | 25  | Not Used |
| 9   | Digit 2 Segment A | 26  | Not Used |
| 10  | Digit 2 Segment B | 27  | Not Used |
| 11  | Digit 2 Segment C | 28  | Not Used |
| 12  | Digit 2 Segment D | 29  | Not Used |
| 13  | Digit 2 Segment E | 30  | Not Used |
| 14  | Digit 2 Segment F | 31  | Not Used |
| 15  | Digit 2 Segment G | 32  | Not Used |
| 16  | Not Used          | 33  | Not Used |
| 17  | Not Used          | 34  | Not Used |

**TABLE 1—Serial Input Sequence**

### RECOMMENDED DISPLAY PROCESSING

The TSM5000 Series are constructed on a standard printed circuit board substrate and covered with a plastic reflector. The edge connector tab will withstand 230°C for 5 seconds. Permanent damage to the display will result if reflector temperature exceeds 70°C. Since the display is not hermetic, immersion of the entire package during flux and clean operation may cause condensation of flux or cleaner on the underside of the reflector. Only the edge

connectors should be immersed.

Rosin core solder, solid core solder, and low activity organic fluxes are recommended. Freon TF, Isopropanol, Methanol or Ethanol solvents are recommended only at room temperature and for short periods. The use of other solvents or elevated temperature use of the recommended solvents may cause permanent damage to the reflector or display.

### ORDERING INFORMATION

“P” suffix for pins: 0.63” (16.00mm) x 0.025” (0.64mm) square.

**EXAMPLE:**

**TSM5052**—Standard part. **TSM5052P**—Standard part with pins.

The TSM5X52 Series is a CMOS device and normal precautions should be taken to avoid static damage.



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