

# MAX7219/MAX7221

## Serially Interfaced, 8-Digit LED Display Drivers

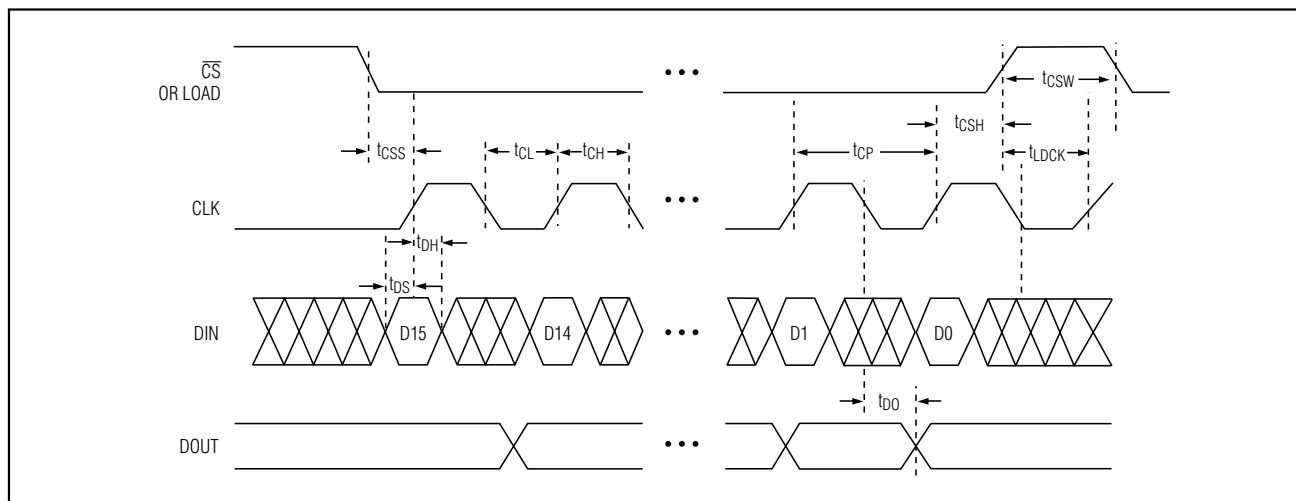


Figure 1. Timing Diagram

Table 1. Serial-Data Format (16 Bits)

| D15 | D14 | D13 | D12 | D11     | D10 | D9 | D8 | D7  | D6   | D5 | D4 | D3 | D2 | D1 | D0  |
|-----|-----|-----|-----|---------|-----|----|----|-----|------|----|----|----|----|----|-----|
| X   | X   | X   | X   | ADDRESS |     |    |    | MSB | DATA |    |    |    |    |    | LSB |

### Detailed Description

#### MAX7219/MAX7221 Differences

The MAX7219 and MAX7221 are identical except for two parameters: the MAX7221 segment drivers are slew-rate limited to reduce electromagnetic interference (EMI), and its serial interface is fully SPI compatible.

#### Serial-Addressing Modes

For the MAX7219, serial data at DIN, sent in 16-bit packets, is shifted into the internal 16-bit shift register with each rising edge of CLK regardless of the state of LOAD. For the MAX7221, CS must be low to clock data in or out. The data is then latched into either the digit or control registers on the rising edge of LOAD/CS. LOAD/CS must go high concurrently with or after the 16th rising clock edge, but before the next rising clock edge or data will be lost. Data at DIN is propagated through the shift register and appears at DOUT 16.5 clock cycles later. Data is clocked out on the falling edge of CLK. Data bits are labeled D0–D15 (Table 1). D8–D11 contain the register address. D0–D7 contain the data, and D12–D15 are “don’t care” bits. The first received is D15, the most significant bit (MSB).

#### Digit and Control Registers

Table 2 lists the 14 addressable digit and control registers. The digit registers are realized with an on-chip, 8x8 dual-port SRAM. They are addressed directly so that individual digits can be updated and retain data as long as V+ typically exceeds 2V. The control registers consist of decode mode, display intensity, scan limit (number of scanned digits), shutdown, and display test (all LEDs on).

#### Shutdown Mode

When the MAX7219 is in shutdown mode, the scan oscillator is halted, all segment current sources are pulled to ground, and all digit drivers are pulled to V+, thereby blanking the display. The MAX7221 is identical, except the drivers are high-impedance. Data in the digit and control registers remains unaltered. Shutdown can be used to save power or as an alarm to flash the display by successively entering and leaving shutdown mode. For minimum supply current in shutdown mode, logic inputs should be at ground or V+ (CMOS-logic levels).

Typically, it takes less than 250μs for the MAX7219/MAX7221 to leave shutdown mode. The display driver can be programmed while in shutdown mode, and shutdown mode can be overridden by the display-test function.