19-4452; Rev 4; 7/03

MAXIM

Serially Interfaced, 8-Digit LED Display Drivers

General Description

The MAX7219/MAX7221 are compact, serial input/output common-cathode display drivers that interface microprocessors (µPs) to 7-segment numeric LED displays of up to 8 digits, bar-graph displays, or 64 individual LEDs. Included on-chip are a BCD code-B decoder, multiplex scan circuitry, segment and digit drivers, and an 8x8 static RAM that stores each digit. Only one external resistor is required to set the segment current for all LEDs. The MAX7221 is compatible with SPI™, QSPI™, and MICROWIRE™, and has slew-rate-limited segment drivers to reduce EMI.

A convenient 4-wire serial interface connects to all common µPs. Individual digits may be addressed and updated without rewriting the entire display. The MAX7219/MAX7221 also allow the user to select code-B decoding or no-decode for each digit.

The devices include a 150µA low-power shutdown mode, analog and digital brightness control, a scan-limit register that allows the user to display from 1 to 8 digits, and a test mode that forces all LEDs on.

For applications requiring 3V operation or segment blinking, refer to the MAX6951 data sheet.

Applications

Bar-Graph Displays
Industrial Controllers
Panel Meters
LED Matrix Displays

Features

- **10MHz Serial Interface**
- **Individual LED Segment Control**
- **Decode/No-Decode Digit Selection**
- **150µA Low-Power Shutdown (Data Retained)**
- **Digital and Analog Brightness Control**
- **Display Blanked on Power-Up**
- **Drive Common-Cathode LED Display**
- **Slew-Rate Limited Segment Drivers for Lower EMI (MAX7221)**
- **SPI, QSPI, MICROWIRE Serial Interface (MAX7221)**
- **24-Pin DIP and SO Packages**

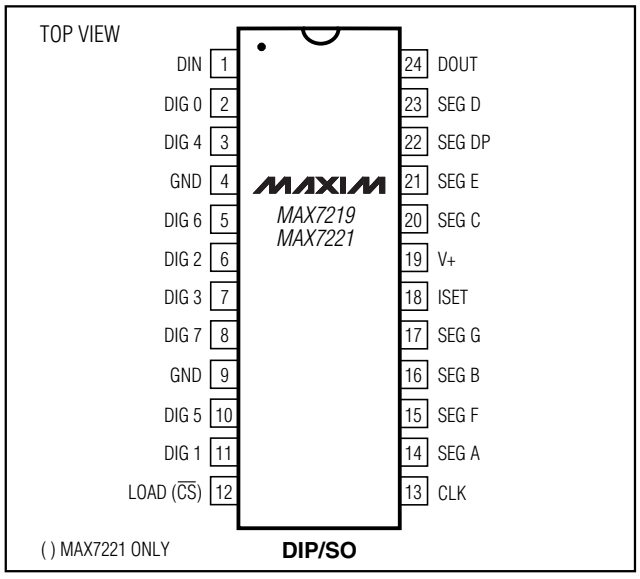
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX7219CNG	0°C to +70°C	24 Narrow Plastic DIP
MAX7219CWG	0°C to +70°C	24 Wide SO
MAX7219C/D	0°C to +70°C	Dice*
MAX7219ENG	-40°C to +85°C	24 Narrow Plastic DIP
MAX7219EWG	-40°C to +85°C	24 Wide SO
MAX7219ERG	-40°C to +85°C	24 Narrow CERDIP

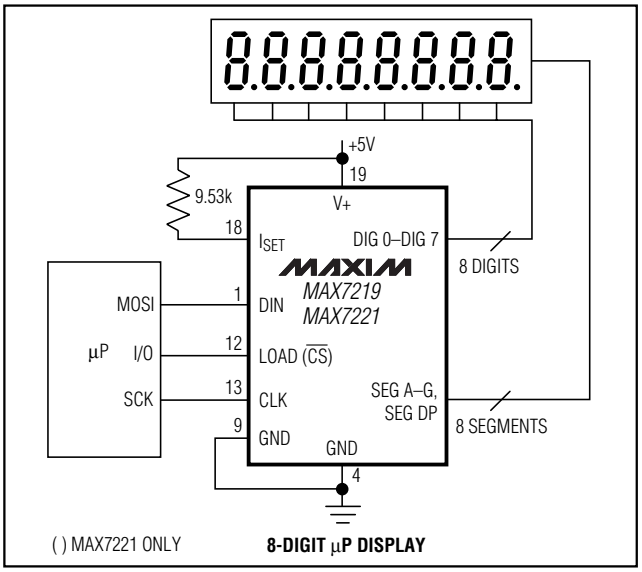
Ordering Information continued at end of data sheet.

**Dice are specified at T_A = +25°C.*

Pin Configuration



Typical Application Circuit



SPI and QSPI are trademarks of Motorola Inc. MICROWIRE is a trademark of National Semiconductor Corp.

Serially Interfaced, 8-Digit LED Display Drivers

ABSOLUTE MAXIMUM RATINGS

Voltage (with respect to GND)
- V+ .....-0.3V to 6V
- DIN, CLK, LOAD, $\overline{CS}$ .....-0.3V to 6V
- All Other Pins.....-0.3V to (V+ + 0.3V)

Current
- DIG0–DIG7 Sink Current.....500mA
- SEGA–G, DP Source Current.....100mA

Continuous Power Dissipation (T_A = +85°C)
- Narrow Plastic DIP (derate 13.3mW/°C above +70°C).....1066mW
- Wide SO (derate 11.8mW/°C above +70°C).....941mW
- Narrow CERDIP (derate 12.5mW/°C above +70°C) ...1000mW

Operating Temperature Ranges (T_{MIN} to T_{MAX})
- MAX7219C_G/MAX7221C_G .....0°C to +70°C
- MAX7219E_G/MAX7221E_G .....-40°C to +85°C

Storage Temperature Range .....-65°C to +160°C

Lead Temperature (soldering, 10s) .....+300°C

Stresses beyond 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 beyond 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.

ELECTRICAL CHARACTERISTICS

(V+ = 5V ±10%, R_{SET} = 9.53kΩ ±1%, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Supply Voltage	V+		4.0		5.5	V
Shutdown Supply Current	I+	All digital inputs at V+ or GND, T_A = +25°C			150	µA
Operating Supply Current	I+	R_{SET} = open circuit			8	mA
		All segments and decimal point on, $I_{SEG\_}$ = -40mA		330		
Display Scan Rate	f_{OSC}	8 digits scanned	500	800	1300	Hz
Digit Drive Sink Current	I_{DIGIT}	V+ = 5V, V_{OUT} = 0.65V	320			mA
Segment Drive Source Current	I_{SEG}	T_A = +25°C, V+ = 5V, V_{OUT} = (V+ - 1V)	-30	-40	-45	mA
Segment Current Slew Rate (MAX7221 only)	$\Delta I_{SEG}/\Delta t$	T_A = +25°C, V+ = 5V, V_{OUT} = (V+ - 1V)	10	20	50	mA/µs
Segment Drive Current Matching	ΔI_{SEG}			3.0		%
Digit Drive Leakage (MAX7221 only)	I_{DIGIT}	Digit off, V_{DIGIT} = V+			-10	µA
Segment Drive Leakage (MAX7221 only)	I_{SEG}	Segment off, V_{SEG} = 0V			1	µA
Digit Drive Source Current (MAX7219 only)	I_{DIGIT}	Digit off, V_{DIGIT} = (V+ - 0.3V)	-2			mA
Segment Drive Sink Current (MAX7219 only)	I_{SEG}	Segment off, V_{SEG} = 0.3V	5			mA