

## General Description

The MIC59P50 parallel-input latched driver is a high-voltage (80V), high-current (500mA) integrated circuit comprised of eight CMOS data latches, a bipolar Darlington transistor driver for each latch, and CMOS control circuitry for the common CLEAR, STROBE, and OUTPUT ENABLE functions. Similar to the MIC5801, additional protection circuitry supplied on this device includes thermal shutdown, under voltage lockout (UVLO), and over-current shutdown.

The bipolar/MOS combination provides an extremely low-power latch with maximum interface flexibility. The MIC59P50 has open-collector outputs capable of sinking 500mA and integral diodes for inductive load transient suppression with a minimum output breakdown voltage rating of 80V above  $V_{EE}$  (50V sustaining). The drivers can be operated with a split supply, where the negative supply is down to -20V and may be paralleled for higher load current capability.

With a 5V logic supply, the MIC59P50 will typically operate at better than 5MHz. With a 12V logic supply, significantly higher speeds are obtained. The CMOS inputs are compatible with standard CMOS, PMOS, and NMOS circuits. TTL circuits may require pull-up resistors.

Each of these eight outputs has an independent over-current shutdown at 500 mA. Upon current shutdown, the affected channel will turn OFF and the flag will go low until  $V_{DD}$  is cycled or the ENABLE/RESET pin is pulsed high. Current pulses less than 2 $\mu$ s will not activate over-current shutdown. Temperatures above 165°C will shut down the device and activate the open collector FLAG output at pin 1. The UVLO circuit disables the outputs at low  $V_{DD}$ ; hysteresis of 0.5V is provided.

## Features

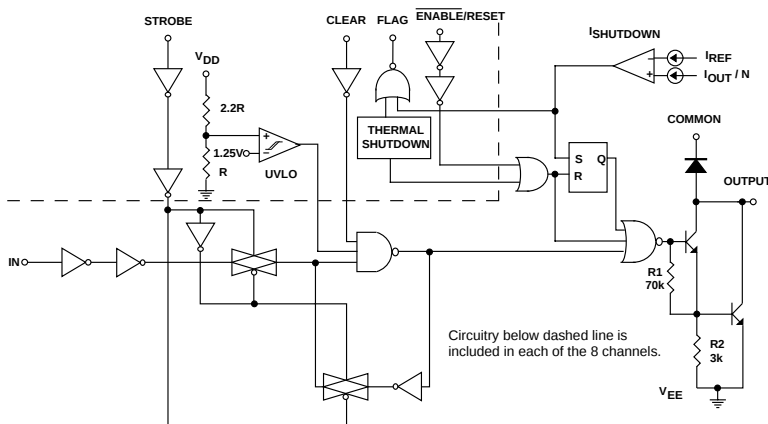
- 4.4 MHz Minimum Data Input Rate
- High-Voltage, High-Current Outputs
- Per-Output Over-Current Shutdown (500mA Typical)
- Undervoltage Lockout
- Thermal Shutdown
- Output Fault Flag
- Output Transient Protection Diodes
- CMOS, PMOS, NMOS, and TTL Compatible Inputs
- Internal Pull-Down Resistors
- Low-Power CMOS Latches
- Single or Split Supply Operation

## Ordering Information

| Part Number | Temperature Range | Package             |
|-------------|-------------------|---------------------|
| MIC59P50BN  | -40°C to +85°C    | 24-Pin Plastic DIP* |
| MIC59P50BV  | -40°C to +85°C    | 28-Pin PLCC         |
| MIC59P50BWM | -40°C to +85°C    | 24-Pin Wide SOIC    |

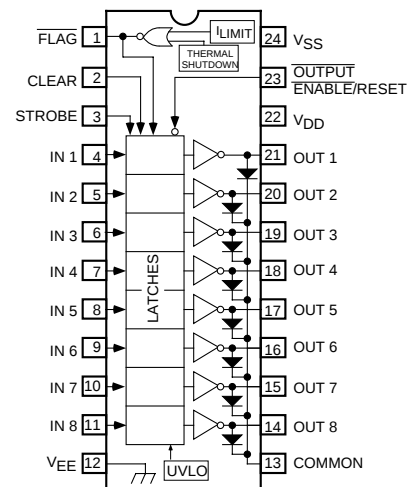
\* 300-mil "skinny DIP"

## Functional Diagram



## Pin Configuration

(DIP and SOIC)



**Absolute Maximum Ratings**  $T_A = +25^\circ\text{C}$ 

Output Voltage ( $V_{CE}$ ) ..... 80V  
 Supply Voltage ( $V_{DD}$ ) ..... 15V  
 ( $V_{DD} - V_{EE}$ ) ..... 25V  
 Input Voltage ( $V_{IN}$ ) .....  $-0.3\text{V}$  to  $V_{DD} + 0.3\text{V}$   
 Continuous Collector Current ( $I_C$ ) ..... 500mA  
 Protected Current ..... 1.5A, **Note 1**

**Power Dissipation ( $P_D$ )**

Plastic DIP (N) ..... 2.4W  
 Derate above  $T_A = +25^\circ\text{C}$  ..... 24mW/ $^\circ\text{C}$   
 PLCC (V) ..... 1.6W  
 Derate above  $T_A = +25^\circ\text{C}$  ..... 16mW/ $^\circ\text{C}$   
 Wide SOIC (WM) ..... 1.4W  
 Derate above  $T_A = +25^\circ\text{C}$  ..... 14mW/ $^\circ\text{C}$

**Operating Temperature ( $T_A$ )**

Plastic DIP (N), PLCC (V), SOIC (WM) ..  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$

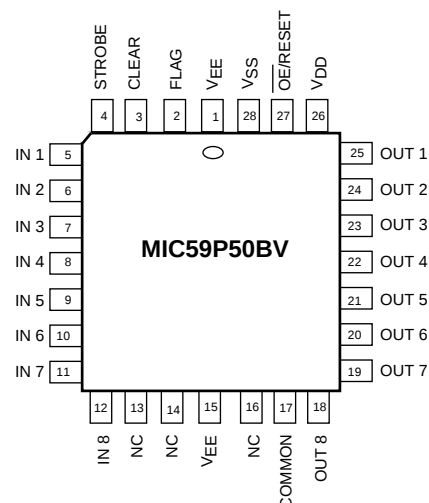
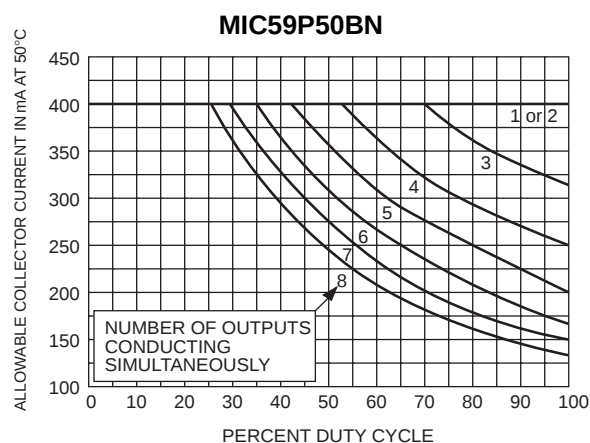
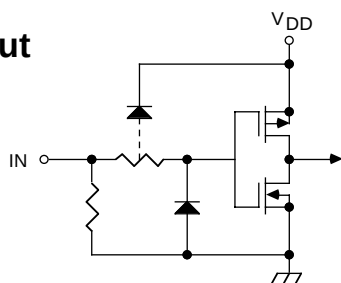
Storage Temperature ( $T_S$ ) .....  $-65^\circ\text{C}$  to  $+150^\circ\text{C}$

Junction Temperature ( $T_J$ ) .....  $+150^\circ\text{C}$

ESD ..... **Note 2**

**Note 1:** Each channel.  $V_{EE}$  connection must be designed to minimize inductance and resistance.

**Note 2:** Devices are input-static protected but can be damage by extremely high static charges.

**PLCC Pin Configuration****Allowable Output Current****Typical Input****Pin Description**

| Pin   | Name                | Description                                                                                                                                                                                       |
|-------|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | FLAG                | Error Flag. Open Collector Output is Low upon Overcurrent Fault or Overtemperature Fault. OUTPUT ENABLE/RESET must be pulled high to reset the flag and fault condition.                          |
| 2     | CLEAR               | Sets All Latches OFF (open).                                                                                                                                                                      |
| 3     | STROBE              | Input Strobe Pin. Loads output latches when High.                                                                                                                                                 |
| 4–11  | INPUT               | Parallel Inputs, 1 through 8                                                                                                                                                                      |
| 12    | $V_{EE}$            | Output Ground (Substrate). Most negative voltage in the system connects here.                                                                                                                     |
| 13    | COMMON              | Transient suppression diodes cathode common pin.                                                                                                                                                  |
| 14–21 | OUTPUT              | Parallel Outputs, 8 through 1.                                                                                                                                                                    |
| 22    | $V_{DD}$            | Logic Positive Supply voltage.                                                                                                                                                                    |
| 23    | OUTPUT ENABLE RESET | Output Enable Reset. When Low, Outputs are active. When High, outputs are inactive and the Flag and outputs are reset from a fault condition. An undervoltage condition emulates a high OE input. |
| 24    | $V_{SS}$            | Logic reference (Ground) pin.                                                                                                                                                                     |

## Electrical Characteristics

$V_{DD} = 5V$ ;  $T_A = +25^{\circ}C$ ; unless noted.

| Characteristic              | Symbol                               | Test Conditions                                                                                  | Limits             |                   |                    | Units       |
|-----------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------|--------------------|-------------------|--------------------|-------------|
|                             |                                      |                                                                                                  | Min.               | Typ.              | Max.               |             |
| Output Leakage Current      | $I_{CEX}$                            | $V_{CE} = 80V$ , $T_A = +25^{\circ}C$<br>$V_{CE} = 80V$ , $T_A = +70^{\circ}C$                   |                    |                   | 50<br>100          | $\mu A$     |
| Collector-Emitter           | $V_{CE(SAT)}$                        | $I_C = 100\text{ mA}$                                                                            |                    | 0.9               | 1.1                | V           |
| Saturation Voltage          |                                      | $I_C = 200\text{ mA}$<br>$I_C = 350\text{ mA}$                                                   |                    | 1.1<br>1.3        | 1.3<br>1.6         |             |
| Input Voltage               | $V_{IN(0)}$                          |                                                                                                  |                    |                   | 1.0                | V           |
|                             | $V_{IN(1)}$                          | $V_{DD} = 12V$<br>$V_{DD} = 10V$<br>$V_{DD} = 5.0V$ <b>Note 3</b>                                | 10.5<br>8.5<br>3.5 |                   |                    |             |
| Input Resistance            | $R_{IN}$                             | $V_{DD} = 12V$                                                                                   | 50                 | 200               |                    | $k\Omega$   |
|                             |                                      | $V_{DD} = 10V$                                                                                   | 50                 | 300               |                    |             |
|                             |                                      | $V_{DD} = 5.0V$                                                                                  | 50                 | 600               |                    |             |
| Flag Output Current         | $I_{OL}$                             | $V_{OL} = 0.4V$                                                                                  |                    | 15                |                    | mA          |
| Flag Output Leakage         | $I_{OH}$                             | $V_{OH} = 12.0V$                                                                                 |                    | 50                |                    | nA          |
| Supply Current              | $I_{DD(ON)}$<br>(One output active)  | $V_{DD} = 12V$ , Outputs Open<br>$V_{DD} = 10V$ , Outputs Open<br>$V_{DD} = 5.0V$ , Outputs Open |                    | 3.3<br>3.1<br>2.4 | 4.5<br>4.5<br>3.6  | mA          |
|                             | $I_{DD(ON)}$<br>(All outputs active) | $V_{DD} = 12V$ , Outputs Open<br>$V_{DD} = 10V$ , Outputs Open<br>$V_{DD} = 5.0V$ , Outputs Open |                    | 6.4<br>6.0<br>4.7 | 10.0<br>9.0<br>7.5 | mA          |
|                             | $I_{DD(OFF)}$<br>(Total)             | $V_{DD} = 12V$ , Outputs Open, Inputs = 0V<br>$V_{DD} = 5.0V$ , Outputs Open, Inputs = 0V        |                    | 3.0<br>2.2        | 4.5<br>3.6         | mA          |
| Clamp Diode Leakage Current | $I_R$                                | $V_R = 80V$ , $T_A = +25^{\circ}C$<br>$V_R = 80V$ , $T_A = +70^{\circ}C$                         |                    |                   | 50<br>100          | $\mu A$     |
| Over-Current Threshold      | $I_{LIM}$                            | Each Output                                                                                      |                    | 500               |                    | mA          |
| Start-Up Voltage            | $V_{SU}$                             | <b>Note 4</b>                                                                                    | 3.5                | 4.0               | 4.5                | V           |
| Minimum Operating $V_{DD}$  | $V_{DD\text{ MIN}}$                  |                                                                                                  | 3.0                | 3.5               | 4.0                | V           |
| Clamp Diode Forward Voltage | $V_F$                                | $I_F = 350\text{ mA}$                                                                            |                    | 1.7               | 2.0                | V           |
| Thermal Shutdown            |                                      |                                                                                                  |                    | 165               |                    | $^{\circ}C$ |
| Thermal Shutdown Hysteresis |                                      |                                                                                                  |                    | 10                |                    |             |

**NOTE 3:** Operation of these devices with standard TTL or DTL may require the use of appropriate pull-up resistors to insure a minimum logic "1".

**NOTE 4:** Undervoltage lockout is guaranteed to release device at no more than 4.5V and disable the device at no less than 3.0V input logic voltage.

## Truth Table

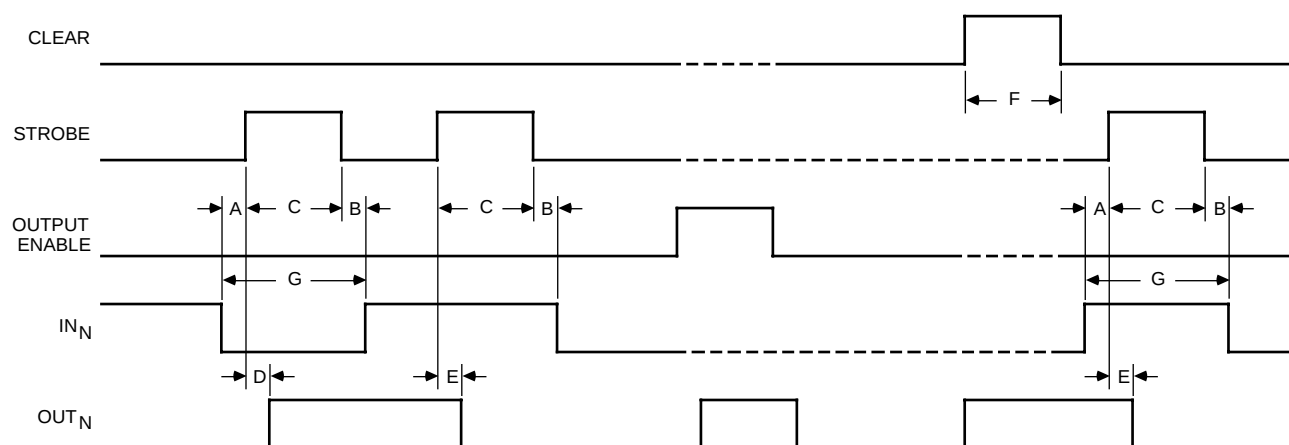
| $IN_N$ | Strobe | Clear | Output Enable | $OUT_N$ |     |
|--------|--------|-------|---------------|---------|-----|
|        |        |       |               | t-1     | t   |
| 0      | 1      | 0     | 0             | X       | OFF |
| 1      | 1      | 0     | 0             | X       | ON  |
| X      | X      | 1     | X             | X       | OFF |
| X      | X      | X     | 1             | X       | OFF |
| X      | 0      | 0     | 0             | ON      | ON  |
| X      | 0      | 0     | 0             | OFF     | OFF |

X = Irrelevant

t-1 = previous output state

t = present output state

Information present at an input is transferred to its latch when the STROBE is high. A high CLEAR input will set all latches to the output OFF condition regardless of the data or STROBE input levels. A high OUTPUT ENABLE will set all outputs to the off condition, regardless of any other input conditions. When the OUTPUT ENABLE is low, the outputs depend on the state of their respective latches. If current shutdown is activated, the OUTPUT ENABLE must be pulsed high to restore operation and reset the Flag. Over temperature faults are not latched and require no reset pulse.

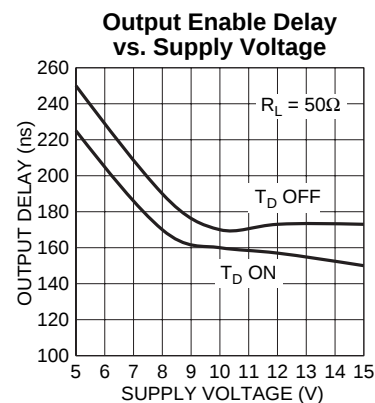
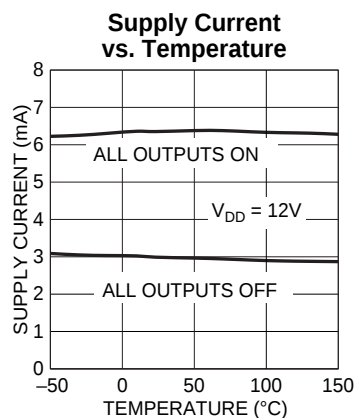
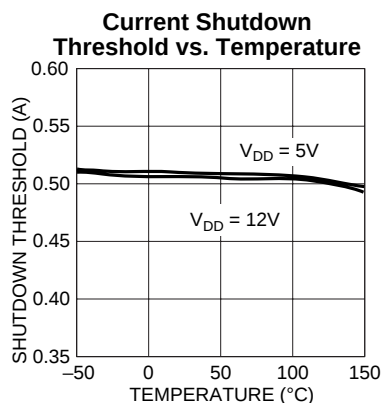
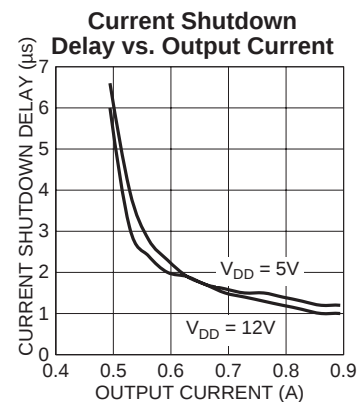
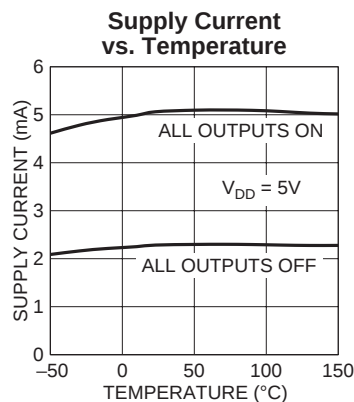
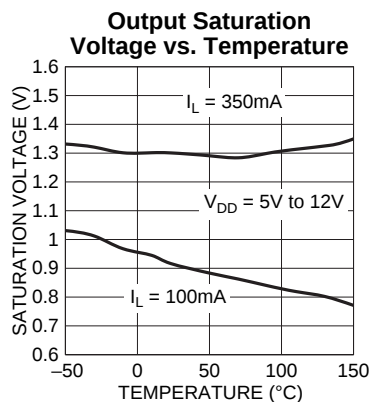


## Timing Conditions

( $T_A = +25^\circ\text{C}$ , Logic Levels are  $V_{DD}$  and  $V_{SS}$ ,  $V_{DD} = 5\text{V}$ ).

|    |                                                                        |        |
|----|------------------------------------------------------------------------|--------|
| A. | Minimum data active time before strobe enabled (data set-up time)      | 50 ns  |
| B. | Minimum data active time after strobe disabled (data hold time)        | 50 ns  |
| C. | Minimum strobe pulse width                                             | 125 ns |
| D. | Typical time between strobe activation and output on to off transition | 500 ns |
| E. | Typical time between strobe activation and output off to on transition | 500 ns |
| F. | Minimum clear pulse width                                              | 300 ns |
| G. | Minimum data pulse width                                               | 225 ns |

## Typical Characteristic Curves



## Typical Applications

### MIC59P50 Protected Relay Driver

