

### General Description

The MIC8030 is a CMOS high voltage liquid crystal display driver. Up to 38 segments can be driven from four CMOS level inputs (CLOCK, DATA IN, LOAD and CHIP SELECT). The MIC8030 is rated at 50V. Data is loaded serially into a shift register, and transferred to latches which hold the data until new data is received.

The backplane can be driven from external source, or the internal oscillator can be used. If the internal oscillator is used, the frequency of the backplane will be determined by an external resistor and capacitor. The oscillator need not be used if a DC output is desired.

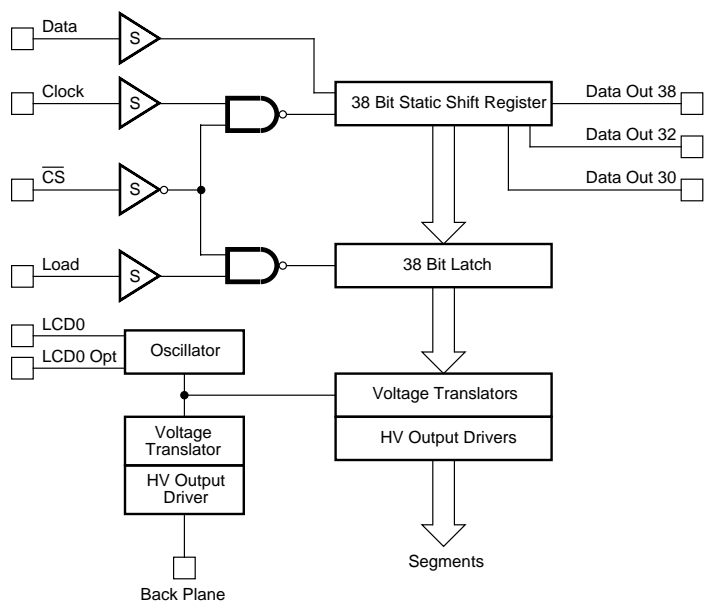
### Features

- High Voltage Outputs capable of a driving up to 100 volt outputs from 5 to 15 volt logic
- Drives 30, 32, or 38 segments
- Cascadable
- On chip Oscillator or External Backplane Input
- CMOS construction for wide supply range and low power consumption
- Schmitt Triggers on all inputs
- CMOS, PMOS, and NMOS compatible

### Applications

- Dichroic and Standard Liquid Crystal Displays
- Flat Panel Displays
- Print Head Drives
- Vacuum Fluorescent Displays

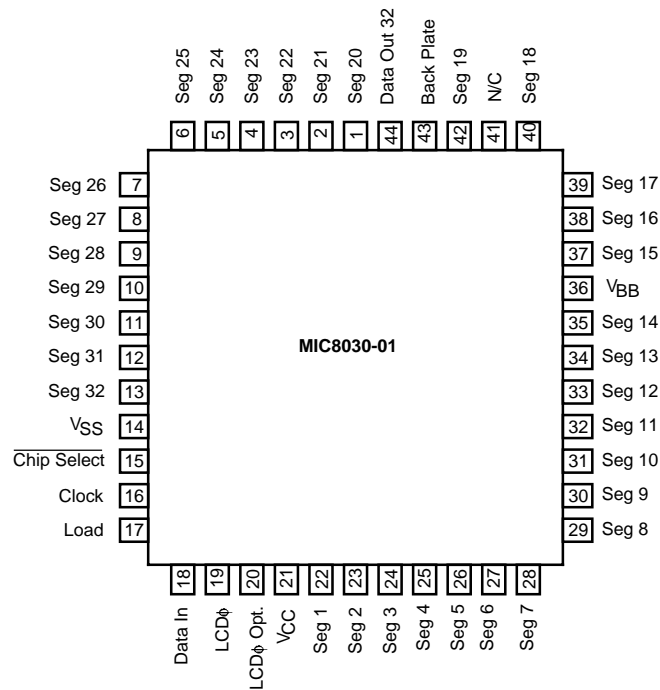
### Functional Diagram



### Ordering Information

Part Number	Temperature Range	Package
MIC8030-01CV	0°C to +70°C	44-pin PLCC

## Pin Configuration



### 44-Pin PLCC (-V)

## Functional Description

With CHIP SELECT tied low, serial data is clocked into the shift register at each falling edge of the CLOCK input. Pulling LOAD high will cause a parallel loading of the shift register contents into the latches. If load is left high, the latches are transparent.

A logic "1" clocked into the shift register corresponds to that segment being on, and that segment is out of phase with the backplane.

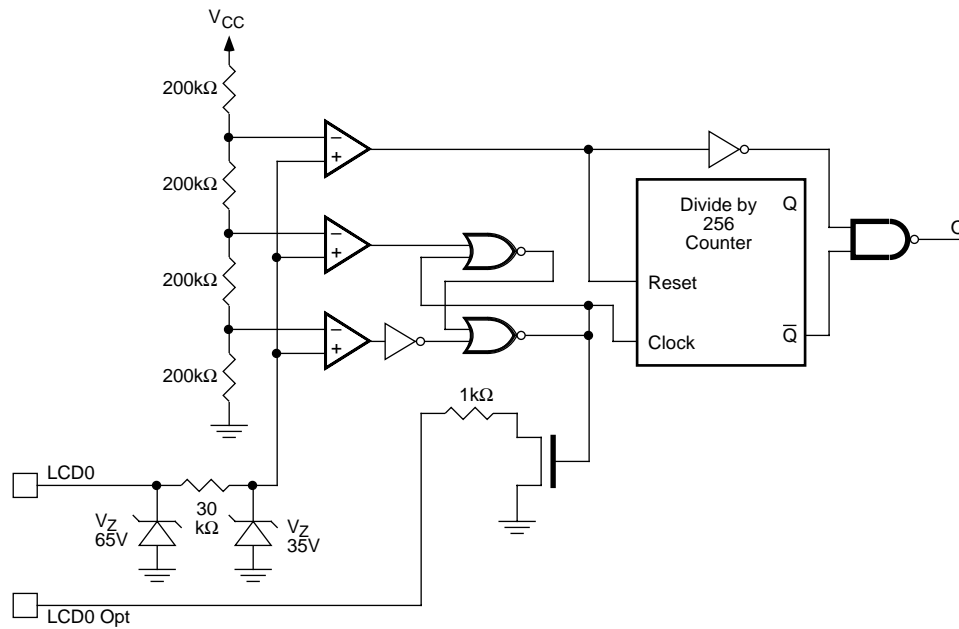
The backplane may be externally driven or the internal oscillator can be used. If LCD $\phi$  is externally driven, the backplane will be in phase with the input; LCD $\phi$  OPT is not connected. The internal oscillator is used by shorting LCD $\phi$  OPT to LCD $\phi$ , connecting a capacitor to ground, and a resistor to V<sub>CC</sub>. The frequency of the backplane will be  $f = 10/[R(C + .0002)]$  at V<sub>DD</sub> = 5V, R in k $\Omega$ , C in  $\mu$ F.

Example: R = 150 k $\Omega$ , C = 420 pF: f = 108 Hz

For displays with more than 38 segments, two or more MIC8030 may be cascaded by connecting DATA OUT of the previous stage with DATA IN of the next stage; CLOCK, LOAD and CHIP SELECT of all following stages should be tied to the control lines of the first MIC8030. The backplane output of the first stage should be tied to LCD $\phi$  of all following stages, the LCD $\phi$  OPT must be left unconnected on those stages. If the internal oscillator is used, and V<sub>BB</sub> > 50V then an external 330 k $\Omega$  resistor must be used between the BACKPLANE of the first stage and LCD $\phi$  of all following stages.

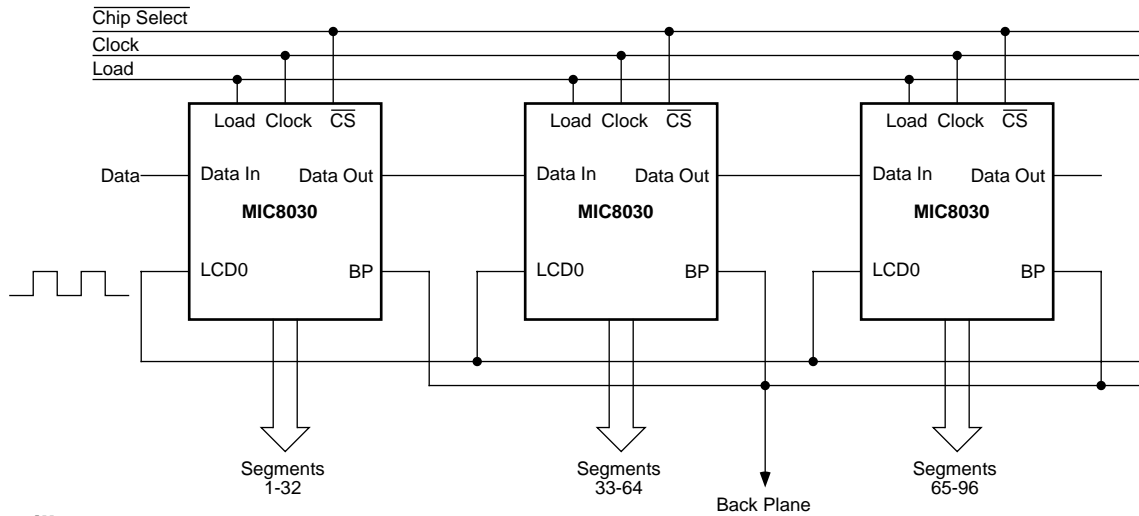
Packaging options available include DATA OUT 30, 32 or 38 with the corresponding number of segments, and the availability of LCD $\phi$  OPT. Types of packages include plastic and ceramic DIPs, surface mount packages, plastic and ceramic Leadless Chip Carriers and custom packaging.

### Internal Oscillator Circuit

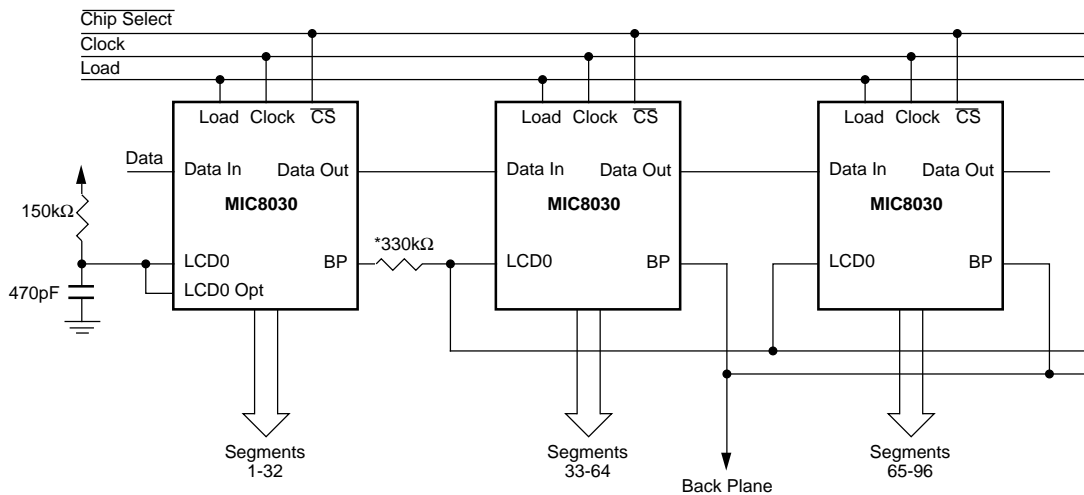


### Typical Application

#### External Oscillator



#### Internal Oscillator



\*Required if using MIC8031 with  $V_{BB} > 50V$ .

## Absolute Maximum Ratings

$V_{CC}$	18V
$V_{BB}$ (MIC8030)	75V
Inputs (CLK, DATA IN, LOAD, $\overline{CS}$ )	-0.5V to 18V
Inputs (LCD0)	-0.5V to 50V
Storage Temperature	-65°C to +150°C
Operating Temperature	-55°C to +125°C
Maximum Current into and out of any segment	20 mA
Maximum Power Dissipation, any segment	50 mW
Maximum Total power dissipation	600 mW

## DC Electrical Characteristics: $V_{CC} = 5V$ , $V_{SS} = 0V$ , $V_{BB} = 50V$ , $-55^{\circ}C \leq T_A \leq +125^{\circ}C$ , unless otherwise noted.

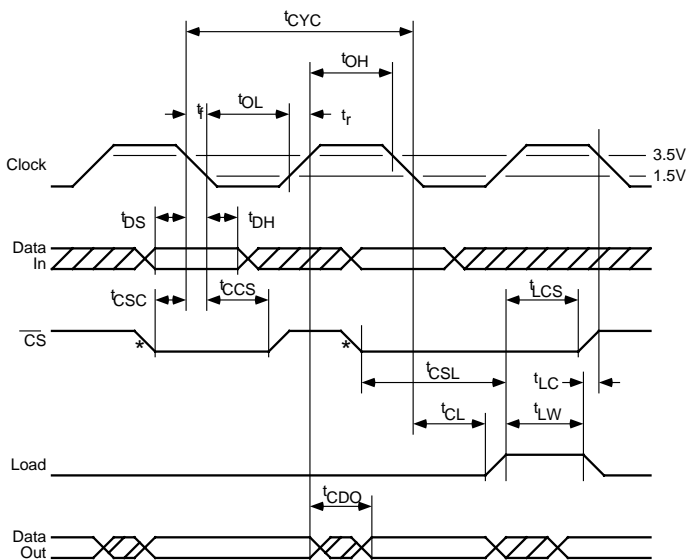
Symbol	Parameter	Condition	Min	Typ	Max	Units
<b>Power Supply</b>						
$V_{CC}$	Logic Supply Voltage		4.5	5	5.5	V
$V_{BB}$	Display Supply Voltage		20	35	50	V
$I_{CC}$	Supply Current (external oscillator)	<b>Note 1</b>		35	250	$\mu A$
	Supply Current (internal oscillator)	<b>Note 1</b>		35	250	$\mu A$
$I_{BB}$	Display Driver Current	$f_{BP} = 100Hz$ , no loads		7	100	$\mu A$
<b>Inputs (CLK, DATA IN, LOAD, <math>\overline{CS}</math>)</b>						
$V_{IH}$	Input High Level		$V_{CC}-1.5$	$V_{CC}-1.8$	$V_{CC}$	V
$V_{IL}$	Input Low Level		0	2.5	2.0	V
$I_L$	Input Leakage Current			<1	5	$\mu A$
$C_I$	Input Capacitance	<b>Note 2</b>		5	10	pF
<b>Input LCD0</b>						
$V_{IH}$	LCD0 Input High Level	Externally driven	$0.9V_{CC}$	$V_{CC}$	50	V
$V_{IL}$	LCD0 Input Low Level	Externally driven	-0.5V	0	$0.1V_{CC}$	V
$I_{LCD0}$	LCD0 Leakage Current	$V_{LCD0} = 15V$		2	10	$\mu A$
$I_{LCD0}$	LCD0 Leakage Current	$V_{LCD0} = 35V$		6	100	$\mu A$
$I_{LCD0}$	LCD0 Leakage Current	$V_{LCD0} = 50V$			1	mA
<b>Capacitance Loads (typical)</b>						
$C_{LSEG}$	Segment Output	$f_{BP} < 100Hz$			100	pF
$C_{LBP}$	Backplane Output	$f_{BP} < 100Hz$			4000	pF
$V_{OAVG}$	DC Bias (Average) Any Segment	$f_{BP} < 100Hz$ , <b>Note 2</b>			+25	mV
<b>Output to Backplane</b>						
$R_{SEG}$	Segment Output Impedance	$I_L = 100\mu A$		1.4	10	k $\Omega$
$R_{BP}$	Backplane Output Impedance	$I_L = 100\mu A$		170	312	$\Omega$
$R_{DATA OUT}$	Data Out Output Impedance	$I_L = 100\mu A$		1.8	3	k $\Omega$

**Note 1:** CMOS input levels. No loads.

**Note 2:** Guaranteed by design but not tested on a production basis.

**AC Electrical Characteristics:**  $V_{CC} = 5V$ ,  $V_{SS} = 0V$ ,  $V_{BB} = 50V$ ,  $-55^{\circ}C \leq T_A \leq +125^{\circ}C$ 

Symbol	Parameter	Min	Typ	Max	Units
$t_{CYC}$	Cycle Time	500			ns
$t_{OL}, t_{OH}$	Clock Pulse Width low/high	250			ns
$t_r, t_f$	Clock rise/fall			1	$\mu s$
$t_{DS}$	Data In Setup	100			ns
$t_{CSC}$	$\overline{CS}$ Setup to Clock	100			ns
$t_{DH}$	Data Hold	10			ns
$t_{CCS}$	$\overline{CS}$ Hold	220			ns
$t_{CL}$	Load Pulse Setup	250			ns
$t_{LCS}$	$\overline{CS}$ Hold (rising load to rising $\overline{CS}$ )	200			ns
$t_{LW}$	Load Pulse Width	300			ns
$t_{LC}$	Load Pulse Delay (falling load to falling clock)	0			ns
$t_{CDO}$	Data Out Valid from Clock			220	ns
$t_{CSL}$	$\overline{CS}$ Setup to LOAD	0			ns
$F_{BP}$	Backplane Frequency	50	100	2000	Hz

**Timing Diagram**

\* The  $\overline{CS}$  high-to-low transition will generate a clock pulse.

**Logic Truth Table**

Data In	Clock	Chip Select	Load	$Q_1(SR)$	$Q_N(SR)$	$Q_N(DRIVER)$
X	X	1	X	NC	NC	$Q_N(L)$
0	↑	0	0	NC	NC	$Q_N(L)$
0	↑	0	1	NC	NC	$Q_N(L)$
0	↓	0	0	0	$Q_N - 1 \rightarrow Q_N$	$Q_N(L)$
0	↓	0	1	0	$Q_N - 1 \rightarrow Q_N$	$Q_N(SR)$
1	↑	0	0	NC	NC	$Q_N(L)$
1	↑	0	1	NC	NC	$Q_N(L)$
1	↓	0	0	1	$Q_N - 1 \rightarrow Q_N$	$Q_N(L)$
1	↓	0	1	1	$Q_N - 1 \rightarrow Q_N$	$Q_N(SR)$

↑ = Rising Edge, ↓ = Falling Edge