MOTOROLA

MC14547B

CMOS MSI

(LOW-POWER COMPLEMENTARY MOS)

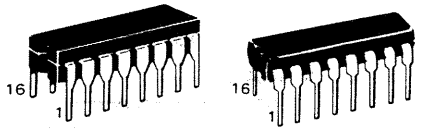
HIGH CURRENT
BCD TO-SEVEN SEGMENT
DECODER/DRIVER

BDC-TO-SEVEN SEGMENT DECODER/DRIVER

The MC14547 BCD-to-seven segment decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of an 8421 BCD-to-seven segment decoder with high output drive capability. Blanking (BI), can be used to turn off or pulse modulate the brightness of the display. The MC14547 can drive seven-segment light-emitting diodes (LED), incandescent, fluorescent or gas discharge readouts either directly or indirectly.

Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

- High Current Sourcing Outputs (Up to 65 mA)
- Low Logic Circuit Power Dissipation
- Supply Voltage Range = +3.0 V to +18 V
- Blanking Input
- Readout Blanking on All Illegal Combinations
- Lamp Intensity Modulation Capability
- Multiplexing Capability
- Capable of Driving Two Low-Power TTL Loads, One Low-Power Schottky TTL Load or Two HTL Loads over the Rated Temperature Range
- Use MC14511B for Applications Requiring Data Latches

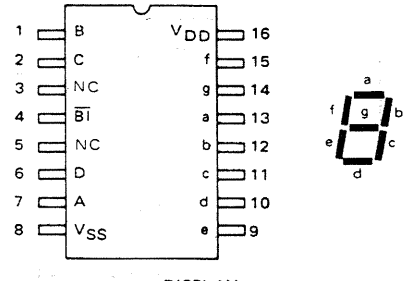


L SUFFIX
CERAMIC PACKAGE
CASE 620

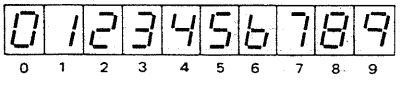
P SUFFIX
PLASTIC PACKAGE
CASE 648

ORDERING INFORMATION

MC14XXXB — Suffix Denotes
- L Ceramic Package
- P Plastic Package
- A Extended Operating Temperature Range
- C Limited Operating Temperature Range



DISPLAY



MAXIMUM RATINGS (Voltage referenced to V_{SS}, Pin 8)

Rating	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	+18 to −0.5	Vdc
Input Voltage, All Inputs	V_{in}	V_{DD} to −0.5	Vdc
Operating Temperature Range MC14547BAL MC14547BCL/CP	T_A	−55 to +125 −40 to +85	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C
Maximum Continuous Output Drive Current (Source) per Output	I_{OHmax}	65	mA
Maximum Continuous Power Dissipation	P_{OHmax}	1200*	mW

*See power derating curve (Figure 1).

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. A destructive high current mode may occure if V_{in} and V_{out} is not constrained to the range $V_{SS} \leqslant (V_{in}$ or $V_{out}) \leqslant V_{DD}$.

Due to the sourcing capability of this circuit, damage can occur to the device if V_{DD} is applied, and the outputs are shorted to V_{SS} and are at a logical 1 (See Maximum Ratings).

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}).

TRUTH TABLE

INPUTS					OUTPUTS						
BI	D	C	B	A	a	b	c	d	e	f	g	DISPLAY
0	X	X	X	X	0	0	0	0	0	0	0	Blank
1	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	1	0	1	1	0	0	0	0	1
1	0	0	1	0	1	1	0	1	1	0	1	2
1	0	0	1	1	1	1	1	1	0	0	1	3
1	0	1	0	0	0	1	1	0	0	1	1	4
1	0	1	0	1	1	0	1	1	0	1	1	5
1	0	1	1	0	0	0	1	1	1	1	1	6
1	0	1	1	1	1	1	1	0	0	0	0	7
1	1	0	0	0	1	1	1	1	1	1	1	8
1	1	0	0	1	1	1	1	0	0	1	1	9
1	1	0	1	0	0	0	0	0	0	0	0	Blank
1	1	0	1	1	0	0	0	0	0	0	0	Blank
1	1	1	0	0	0	0	0	0	0	0	0	Blank
1	1	1	0	1	0	0	0	0	0	0	0	Blank
1	1	1	1	0	0	0	0	0	0	0	0	Blank
1	1	1	1	1	0	0	0	0	0	0	0	Blank

X = Don't care

DS9807

ELECTRICAL CHARACTERISTICS

Characteristic		Symbol	V_{DD} Vdc	T_{low}* Min	T_{low}* Max	25°C Min	25°C Typ	25°C Max	T_{high}* Min	T_{high}* Max	Unit
Output Voltage V_{in} = V_{DD} or 0	"0" Level	V_{OL}	5.0 10 15	– – –	0.05 0.05 0.05	– – –	0 0 0	0.05 0.05 0.05	– – –	0.05 0.05 0.05	Vdc
V_{in} = 0 or V_{DD}	"1" Level	V_{OH}	5.0 10 15	4.1 9.1 14.1	– – –	4.4 9.4 14.4	4.6 9.6 14.6	– – –	4.3 9.3 14.4	– – –	Vdc
Input Voltage # (V_O = 3.8 or 0.5 Vdc) (V_O = 8.8 or 1.0 Vdc) (V_O = 13.8 or 1.5 Vdc)	"0" Level	V_{IL}	5.0 10 15	– – –	1.5 3.0 4.0	– – –	2.25 4.50 6.75	1.5 3.0 4.0	– – –	1.5 3.0 4.0	Vdc
(V_O = 0.5 or 3.8 Vdc) (V_O = 1.0 or 8.8 Vdc) (V_O = 1.5 or 13.8 Vdc)	"1" Level	V_{IH}	5.0 10 15	3.5 7.0 11.0	– – –	3.5 7.0 11.0	2.75 5.50 8.25	– – –	3.5 7.0 11.0	– – –	Vdc
Output Drive Voltage (AL Device) (I_{OH} = 5.0 mAdc) (I_{OH} = 10 mAdc) (I_{OH} = 20 mAdc) (I_{OH} = 40 mAdc) (I_{OH} = 65 mAdc)	Source	V_{OH}	5.0	4.0 – 3.8 – 3.1	– – – – –	4.2 4.1 3.9 3.7 3.2	4.3 4.3 4.2 4.0 3.7	– – – – –	4.3 – 4.0 – 3.0	– – – – –	Vdc
(I_{OH} = 5.0 mAdc) (I_{OH} = 10 mAdc) (I_{OH} = 20 mAdc) (I_{OH} = 40 mAdc) (I_{OH} = 65 mAdc)			10	9.1 – 8.8 – 8.4	– – – – –	9.2 9.1 9.0 8.9 8.5	9.3 9.3 9.2 9.0 8.8	– – – – –	9.3 – 9.2 – 8.1	– – – – –	Vdc
(I_{OH} = 5.0 mAdc) (I_{OH} = 10 mAdc) (I_{OH} = 20 mAdc) (I_{OH} = 40 mAdc) (I_{OH} = 65 mAdc)			15	14.0 – 13.8 – 13.5	– – – – –	14.2 14.1 14.0 13.8 13.5	14.3 14.3 14.2 14.0 13.7	– – – – –	14.4 – 14.2 – 13.3	– – – – –	Vdc
Output Drive Voltage (CL/CP Device) (I_{OH} = 5.0 mAdc) (I_{OH} = 10 mAdc) (I_{OH} = 20 mAdc) (I_{OH} = 40 mAdc) (I_{OH} = 65 mAdc)	Source	V_{OH}	5.0	3.9 – 3.6 – 3.0	– – – – –	4.1 4.0 3.8 3.5 3.0	4.3 4.3 4.2 4.0 3.7	– – – – –	4.2 – 3.9 – 2.9	– – – – –	Vdc
(I_{OH} = 5.0 mAdc) (I_{OH} = 10 mAdc) (I_{OH} = 20 mAdc) (I_{OH} = 40 mAdc) (I_{OH} = 65 mAdc)			10	8.9 – 8.6 – 8.0	– – – – –	9.1 9.0 8.8 8.5 8.1	9.3 9.3 9.2 9.0 8.8	– – – – –	9.2 – 9.0 – 8.0	– – – – –	Vdc
(I_{OH} = 5.0 mAdc) (I_{OH} = 10 mAdc) (I_{OH} = 20 mAdc) (I_{OH} = 40 mAdc) (I_{OH} = 65 mAdc)			15	13.9 – 13.6 – 13.0	– – – – –	14.1 -14.0 13.8 13.5 13.0	14.3 14.3 14.2 14.0 13.7	– – – – –	14.2 – 14.0 – 13.0	– – – – –	Vdc
Output Drive Current (AL Device) (V_{OL} = 0.4 Vdc) (V_{OL} = 0.5 Vdc) (V_{OL} = 1.5 Vdc)	Sink	I_{OL}	5.0 10 15	0.32 0.80 2.10	– – –	0.26 0.65 1.7	0.44 1.13 4.4	– – –	0.18 0.45 1.2	– – –	mAdc
Output Drive Current (CL/CP Device) (V_{OL} = 0.4 Vdc) (V_{OL} = 0.5 Vdc) (V_{OL} = 1.5 Vdc)	Sink	I_{OL}	5.0 10 15	0.26 0.65 1.8	– – –	0.22 0.55 1.5	0.44 1.13 4.4	– – –	0.18 0.45 1.2	– – –	mAdc

ELECTRICAL CHARACTERISTICS (Continued)

Characteristic	Symbol	V_{DD} Vdc	T_{low}* Min	T_{low}* Max	25°C Min	25°C Typ	25°C Max	T_{high}* Min	T_{high}* Max	Unit
Input Current (AL Device)	I_{in}	15	—	±0.1	—	±0.00001	±0.1	—	±1.0	μAdc
Input Current (CL/CP Device)	I_{in}	15	—	±0.3	—	±0.00001	±0.3	—	±1.0	μAdc
Input Capacitance (V_{in} = 0)	C_{in}	—	—	—	—	5.0	7.5	—	—	pF
Quiescent Current (AL Device) (Per Package)	I_{DD}	5.0 10 15	— — —	5.0 10 20	— — —	0.005 0.010 0.015	5.0 10 20	— — —	150 300 600	μAdc
Quiescent Current (CL/CP Device) (Per Package)	I_{DD}	5.0 10 15	— — —	20 40 80	— — —	0.005 0.010 0.015	20 40 80	— — —	150 300 600	μAdc
Total Supply Current**† (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0 10 15	I_T = (1.9 μA/kHz) f + I_{DD} I_T = (3.8 μA/kHz) f + I_{DD} I_T = (5.7 μA/kHz) f + I_{DD}							μAdc

* T_{low} = −55°C for AL Device, −40°C for CL/CP Device
T_{high} = +125°C for AL Device, +85°C for CL/CP Device

♯ Noise immunity specified for worst-case input combination.
Noise Margin for both "1" and "0" level =
1.0 Vdc min @ V_{DD} = 5.0 Vdc
2.0 Vdc min @ V_{DD} = 10 Vdc
2.5 Vdc min @ V_{DD} = 15 Vdc

† To calculate total supply current at loads other than 50 pF:
$I_T(C_L) = I_T(50\ pF) + 3.5 \times 10^{-3}(C_L - 50) V_{DD} f$
where: I_T is in μA (per package), C_L in pF, V_{DD} in Vdc, and f in kHz is input frequency.

** The formulas given are for the typical characteristics only at 25°C.

SWITCHING CHARACTERISTICS (C_L = 50 pF, T_A = 25°C)

Characteristic	Symbol	V_{DD} Vdc	Min	Typ	Max	Unit
Output Rise Time	t_{TLH}	5.0 10 15	— — —	40 40 40	80 80 80	ns
Output Fall Time	t_{THL}	5.0 10 15	— — —	125 75 70	250 150 140	ns
Data Propagation Delay Time	t_{PLH}	5.0 10 15	— — —	750 300 200	1500 600 400	ns
	t_{PHL}	5.0 10 15	— — —	750 300 200	1500 600 400	ns
Blank Propagation Delay Time	t_{PLH}	5.0 10 15	— — —	750 300 200	1500 600 400	ns
	t_{PHL}	5.0 10 15	— — —	500 250 170	1000 500 340	ns

LOGIC DIAGRAM

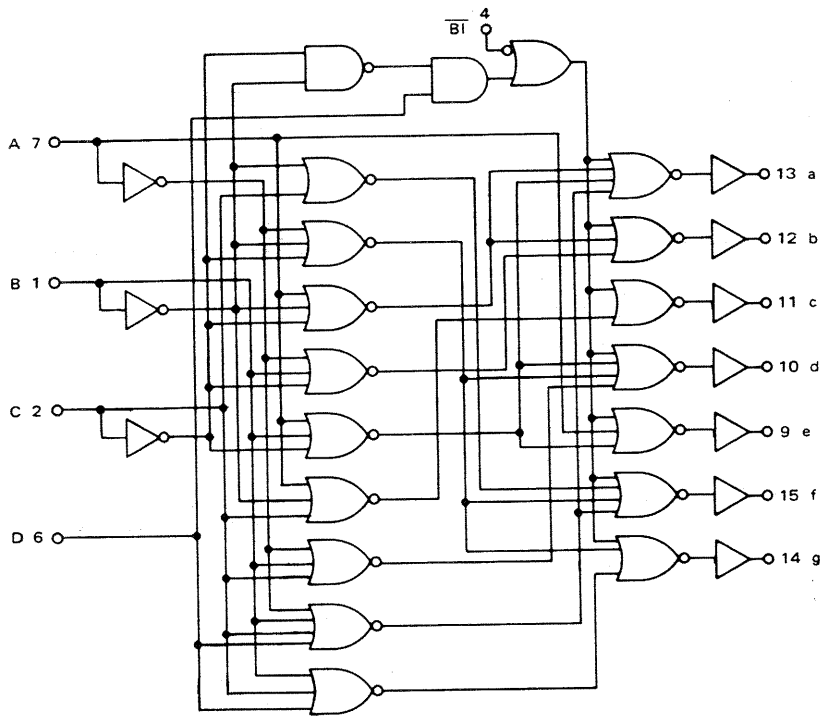
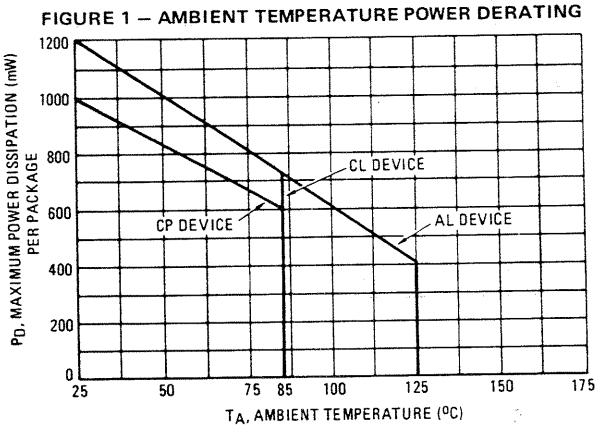
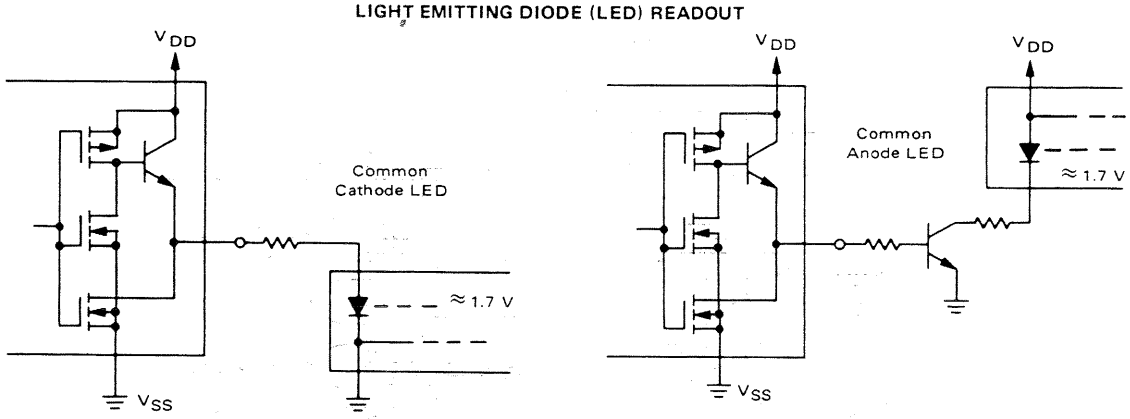


FIGURE 1 – AMBIENT TEMPERATURE POWER DERATING

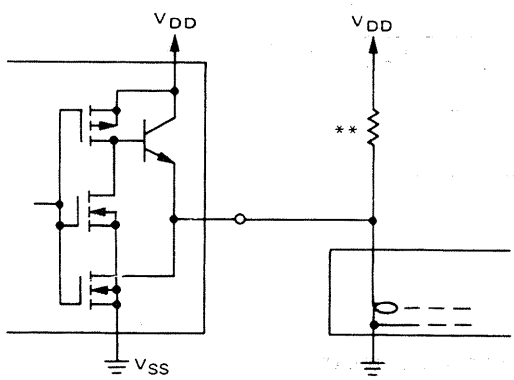


CONNECTIONS TO VARIOUS DISPLAY READOUTS

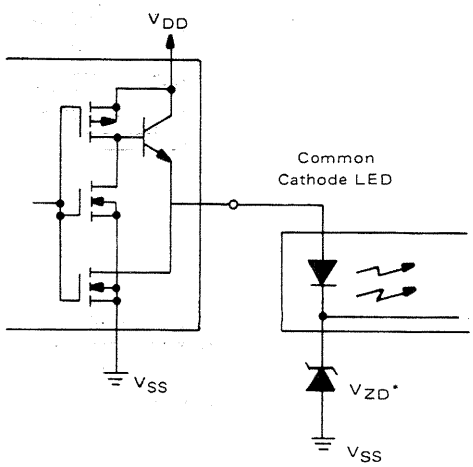
LIGHT EMITTING DIODE (LED) READOUT



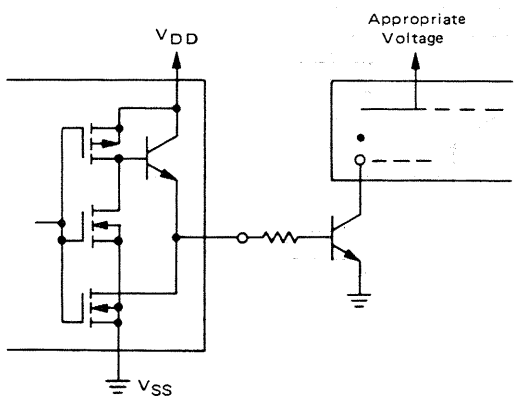
INCANDESCENT READOUT



LIGHT-EMITTING DIODE (LED) READOUT USING A ZENER DIODE TO REPLACE DROPPING RESISTORS



GAS DISCHARGE READOUT



** A filament pre-warm resistor is recommended to reduce filament thermal shock and increase the effective cold resistance of the filament.

* V_{ZD} should be set at $V_{DD} - 1.3\ V - V_{LED}$. Wattage of zener diode must be calculated for number of segments and worst-case conditions.