National **S**emiconductor

March 1988

DS7880/DS8880 High Voltage 7-Segment Decoder/Driver

General Description

The DS7880/DS8880 is custom designed to decode four lines of BCD and drive a gas-filled seven-segment display tube.

Each output constitutes a switchable, adjustable current sink which provides constant current to the tube segment, even with high tube anode supply tolerance or fluctuation. These current sinks have a voltage compliance from 3V to at least 80V; typically the output current varies 1% for output voltage changes of 3 to 50V. Each bit line of the decoder switches a current sink on or off as prescribed by the input code. Each current sink is ratioed to the b-output current as required for even illumination of all segments.

Output currents may be varied over the 0.2 to 1.5 mA range for driving various tube types or multiplex operation. The output current is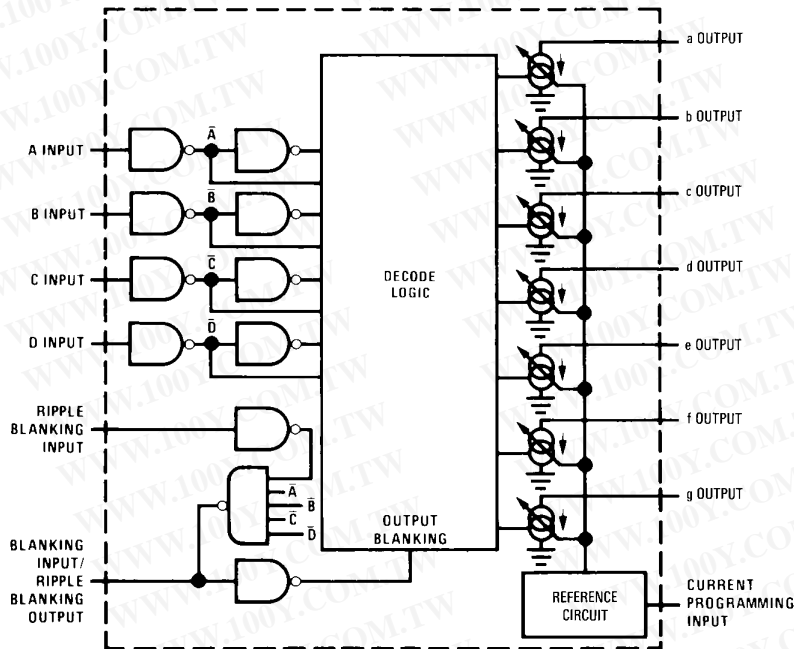 adjusted by connecting an external pro- gram resistor (R_P) from V_{CC} to the Program input in accordance with the programming curve. The circuit design provides a one-to-one correlation between program input current and b-segment output current.

The Blanking Input provides unconditional blanking of any output display, while the Ripple Blanking pins allow simple leading- or trailing-zero blanking.

Features

■ Current sink outputs
■ Adjustable output current—0.2 to 1.5 mA
■ High output breakdown voltage—110V typ
■ Suitable for multiplex operation
■ Blanking and Ripple Blanking provisions
■ Low fan-in and low power

Logic Diagram

TL/F/5845–1

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

V_{CC}	7V
Input Voltage (Except BI)	6V
Input Voltage (BI)	V_{CC}
Segment Output Voltage	80V
Power Dissipation	600 mW
Maximum Power Dissipation* at 25°C	
Cavity Package	1509 mW
Molded Package	1476 mW

*Derate cavity package 10.06 mW/°C above 25°C; derate molded package 11.81 mW/°C above 25°C.

Transient Segment Output Current (Note 4)	50 mA
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 4 sec.)	260°C

Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})			
DS7880	4.5	5.5	V
DS8880	4.75	5.25	V
Temperature (T_A)			
DS7880	−55	+125	°C
DS8880	0	+70	°C

Electrical Characteristics (Notes 2 and 3)

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_{IH}	Logical "1" Input Voltage	V_{CC} = Min		2.0			V
V_{IL}	Logical "0" Input Voltage	V_{CC} = Min				0.8	V
V_{OH}	Logical "1" Output Voltage	V_{CC} = Min, I_{OUT} = −200 µA, RBO		2.4	3.7		V
V_{OL}	Logical "0" Output Voltage	V_{CC} = Min, I_{OUT} = 8 mA, RBO			0.13	0.4	V
I_{IH}	Logical "1" Input Current	V_{CC} = Max, Except BI	V_{IN} = 2.4V		2	15	µA
			V_{IN} = 5.5V		4	400	µA
I_{IL}	Logical "0" Input Current	V_{CC} = Max, V_{IN} = 0.4V	Except BI		−300	−600	µA
			BI		−1.2	−2.0	mA
I_{CC}	Power Supply Current	V_{CC} = Max, R_p = 2.2k, All Inputs = 0V			27	43	mA
V_{CD}	Input Diode Clamp Voltage	V_{CC} = Max, T_A = 25°C, I_{IN} = 12 mA			−0.9	−1.5	V
I_O	SEGMENT OUTPUTS "ON" Current Ratio	All Outputs = 50V, I_{OUT}b = Ref.	Outputs a, f, and g	0.84	0.93	1.02	
			Outut c	1.12	1.25	1.38	
			Output d	0.90	1.00	1.10	
			Output e	0.99	1.10	1.21	
I_b ON	Output b "ON" Current	V_{CC} = 5V, V_{OUT}b = 50V, All Other Outputs ≥ 5V, T_A = 25°C	R_p = 18.1k	0.15	0.20	0.25	mA
			R_p = 7.03k	0.45	0.50	0.55	mA
			R_p = 3.40k	0.90	1.00	1.10	mA
			R_p = 2.20k	1.35	1.50	1.65	mA
V_{SAT}	Output Saturation Voltage	V_{CC} = Min, R_p = 1k±5%, I_{OUT}b = 2 mA, (Note 5)			0.8	2.5	V
I_{CEX}	Output Leakage Current	V_{OUT} = 75V, BI = 0V, R_p = 2.2k			0.003	3	µA
V_{BR}	Output Breakdown Voltage	I_{OUT} = 250 µA, BI = 0V, R_p = 2.2k		80	110		V
t_{pd}	Propagation Delays BCD Input to Segment Output	V_{CC} = 5V, T_A = 25°C			0.4	10	µs
	BI to Segment Output				0.4	10	µs
	RBI to Segment Output				0.7	10	µs
	RBI to RBO				0.4	10	µs

Note 1: "Absolute Maximum Rating" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

Note 2: Unless otherwise specified min/max limits apply across the −55°C to +125°C temperature range for the DS7880 and across the 0°C to +70°C range for the DS8880. All typical values are for T_A = 25°C and V_{CC} = 5V.

Note 3: All currents into device pins shown as positive, out of device pins as negative, all voltages referenced to ground unless otherwise noted. All values shown as max or min or absolute value basis.

Note 4: In all applications transient segment output current must be limited to 50 mA. This may be accomplished in dc applications by connecting a 2.2k resistor from the anode-supply filter capacitor to the display anode, or by current limiting the anode driver in multiplex applications.

Note 5: For saturation mode the segment output currents are externally limited and ratioed.
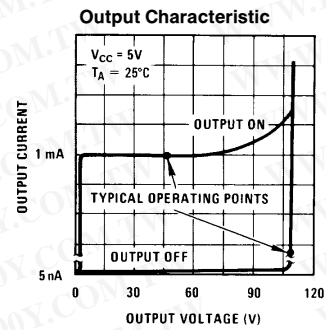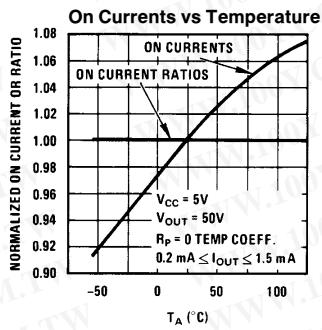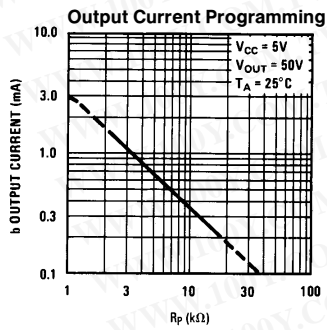
Connection Diagram

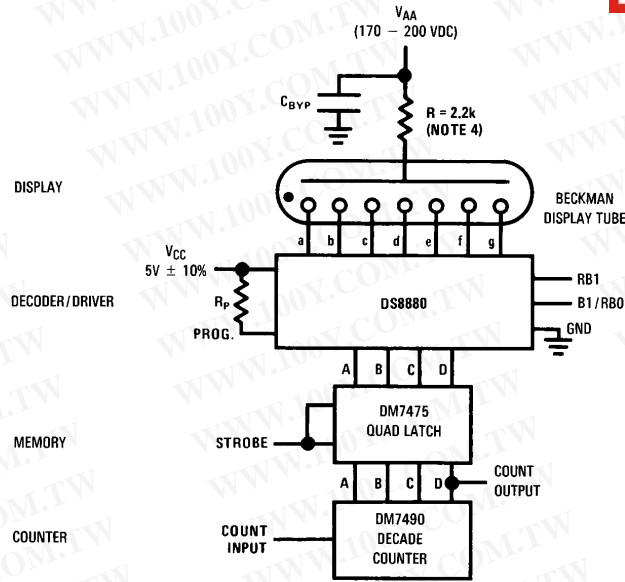**Dual-In-Line Package**
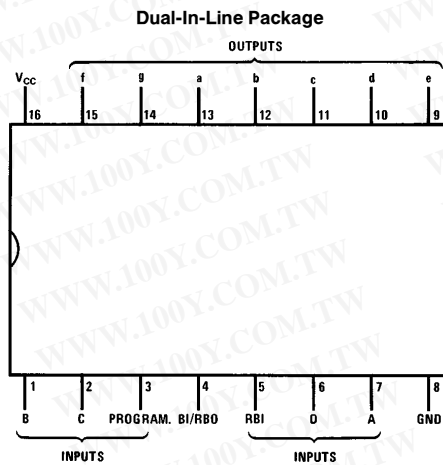
TL/F/5845–2

Top View

**Order Number DS7880J,
DS8880J or DS8880N
See NS Package Number J16A or N16A**

## Typical Performance Characteristics

TL/F/5845–3

Typical Application

TL/F/5845–4

Truth Table

DECIMAL OR FUNCTION	RBI†	D	C	B	A	BI/RBO	a	b	c	d	e	f	g	DISPLAY
0	1	0	0	0	0	1	0	0	0	0	0	0	1	
1	X	0	0	0	1	1	1	0	0	1	1	1	1	
2	X	0	0	1	0	1	0	0	1	0	0	1	0	
3	X	0	0	1	1	1	0	0	0	0	1	1	0	
4	X	0	1	0	0	1	1	0	0	1	1	0	0	
5	X	0	1	0	1	1	0	1	0	0	1	0	0	
6	X	0	1	1	0	1	0	1	0	0	0	0	0	
7	X	0	1	1	1	1	0	0	0	1	1	1	1	
8	X	1	0	0	0	1	0	0	0	0	0	0	0	
9	X	1	0	0	1	1	0	0	0	0	1	0	0	
10	X	1	0	1	0	1	0	0	0	1	0	0	0	
11	X	1	0	1	1	1	1	1	0	0	0	0	0	
12	X	1	1	0	0	1	0	1	1	0	0	0	1	
13	X	1	1	0	1	1	1	0	0	0	0	1	0	
14	X	1	1	1	0	1	0	1	1	0	0	0	0	
15	X	1	1	1	1	1	0	1	1	1	0	0	0	
BI*	X	X	X	X	X	0*	1	1	1	1	1	1	1	
RBI	0	0	0	0	0	0	1	1	1	1	1	1	1	
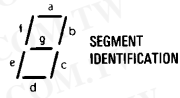
*BI/RBO used as input only   †X = Don't care

TL/F/5845–5

4

Physical Dimensions inches (millimeters)
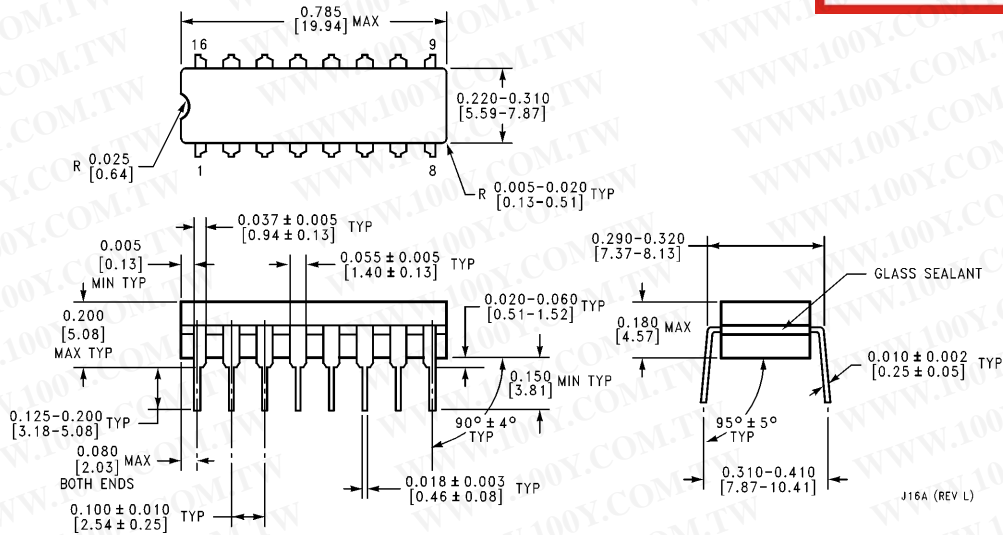
Ceramic Dual-In-Line Package (J)
Order Number DS7880J or DS8880J
NS Package Number J16A

5

Physical Dimensions inches (millimeters) (Continued)

0.092
(2.337)
DIA NOM
(2X)

PIN NO. 1 IDENT

0.090
(2.286)
NOM

0.843–0.870
(21.41–22.10)

0.250 ±0.005
(6.350 ±0.127)

0.280
(7.112)
MIN

0.300–0.320
(7.620–8.128)

0.030
(0.762)
MAX

95° ±5°

0.009–0.015
(0.229–0.381)

0.325
+0.040
−0.015
(8.255
+1.016
−0.381)

0.065
(1.651)

0.060
(1.524)

0.040
(1.016)
TYP

0.075 ±0.015
(1.905 ±0.381)

0.100 ±0.010
(2.540 ±0.254)

0.018 ±0.003
(0.457 ±0.076)

0.130 ±0.005
(3.302 ±0.127)

0.145–0.200
(3.683–5.080)

90° ±4°
TYP

0.125–0.140
(3.175–3.556)

0.020
(0.508)
MIN
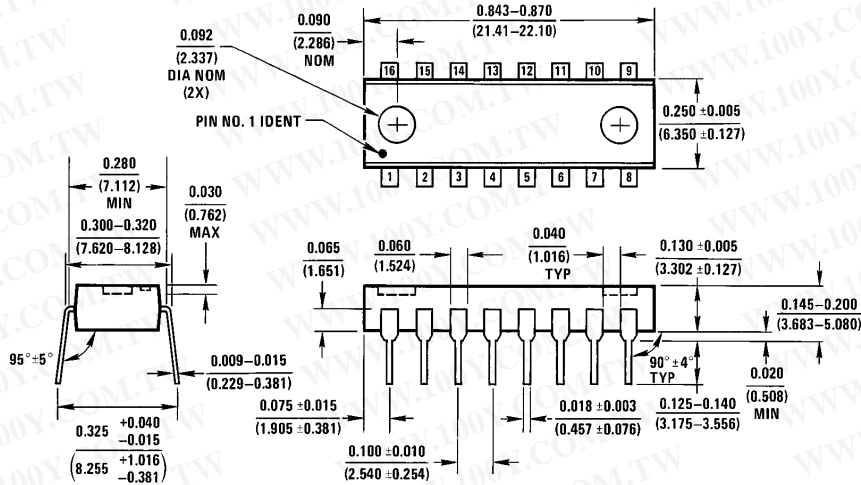
N16A (REV E)

Molded Dual-In-Line Package (N)
Order Number DS8880N
NS Package Number N16A

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