

## 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-

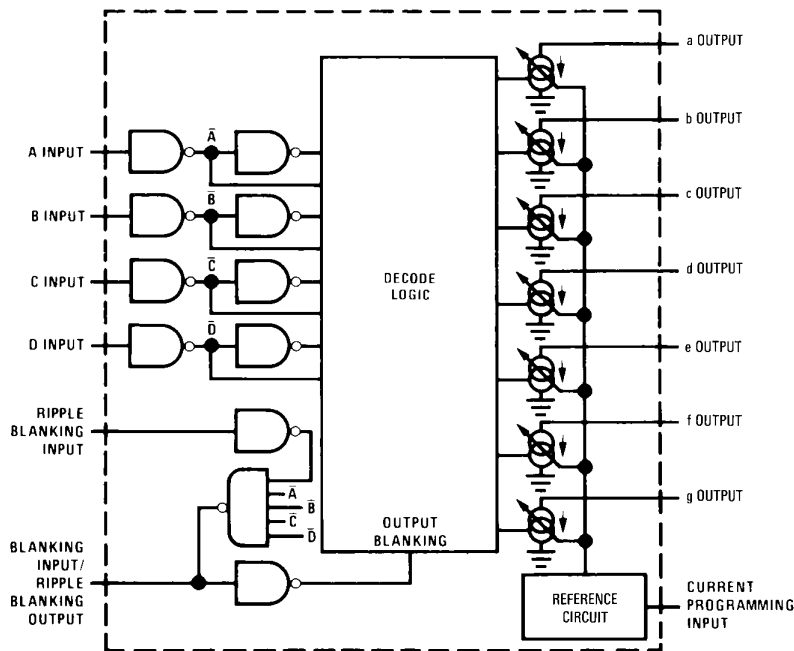
gram resistor ( $R_P$ ) from  $V_{CC}$  to the Program input in accordance with the programming curve. The circuit design provides a one-to-one correlation between program input current and b-segment output current.

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

**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.

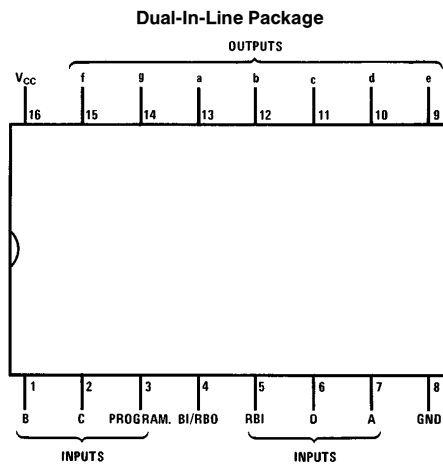
**Note 2:** Unless otherwise specified min/max limits apply across the -55°C to +125°C temperature range for the DS7880 and across the 0°C to +70°C range for the DS8880. All typical values are for  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 5\text{V}$ .

**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.

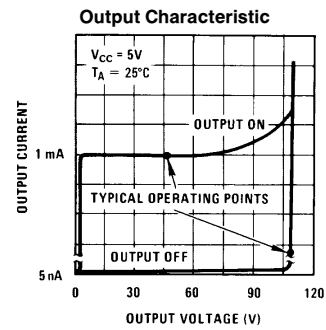
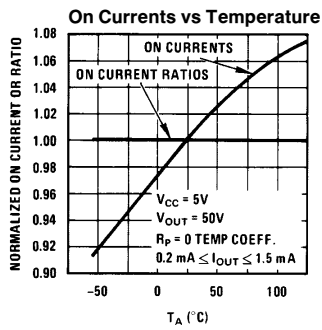
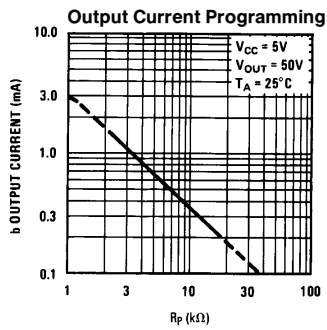
## Connection Diagram



TL/F/5845-2

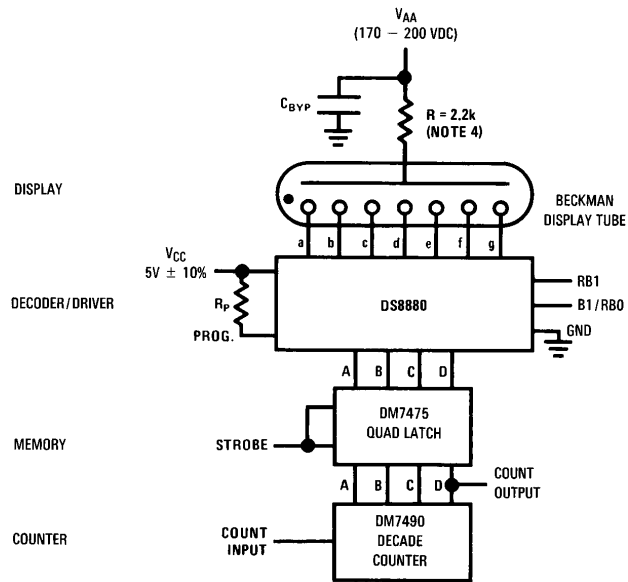
Top View  
 Order Number DS7880J,  
 DS8880J or DS8880N  
 See NS Package Number J16A or N16A

## Typical Performance Characteristics



TL/F/5845-3

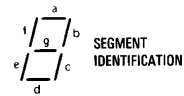
## Typical Application



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	0
1	X	0	0	0	1	1	1	0	0	1	1	1	1	1
2	X	0	0	1	0	1	0	0	1	0	0	1	0	2
3	X	0	0	1	1	1	0	0	0	0	1	1	0	3
4	X	0	1	0	0	1	1	0	0	1	1	0	0	4
5	X	0	1	0	1	1	0	1	0	0	1	0	0	5
6	X	0	1	1	0	1	0	1	0	0	0	0	0	6
7	X	0	1	1	1	1	0	0	0	1	1	1	1	7
8	X	1	0	0	0	1	0	0	0	0	0	0	0	8
9	X	1	0	0	1	1	0	0	0	0	1	0	0	9
10	X	1	0	1	0	1	0	0	0	1	0	0	0	10
11	X	1	0	1	1	1	1	1	0	0	0	0	0	11
12	X	1	1	0	0	1	0	1	1	0	0	0	1	12
13	X	1	1	0	1	1	1	0	0	0	0	1	0	13
14	X	1	1	1	0	1	0	1	1	0	0	0	0	14
15	X	1	1	1	1	1	0	1	1	1	0	0	0	15
BI*	X	X	X	X	X	0*	1	1	1	1	1	1	1	BI
RBI	0	0	0	0	0	0	1	1	1	1	1	1	1	RBI



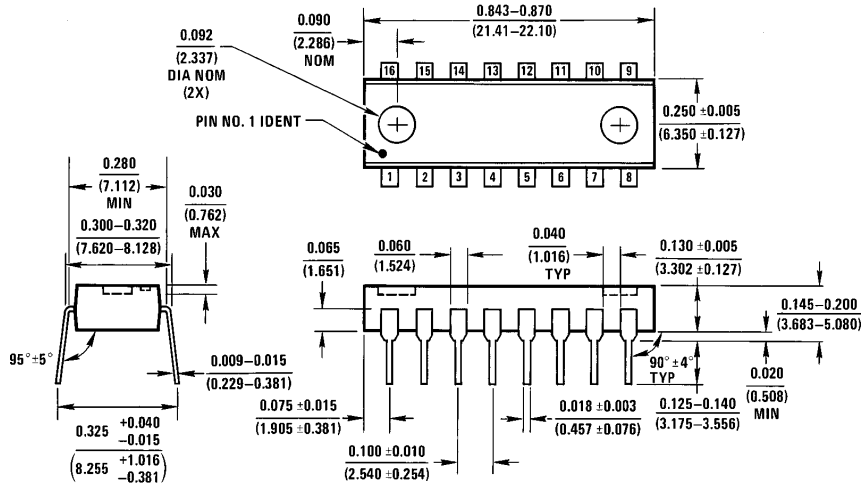
\*BI/RBO used as input only

†X = Don't care

TL/F/5845-5



**Physical Dimensions** inches (millimeters) (Continued)



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

N16A (REV E)

**LIFE SUPPORT POLICY**

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



**National Semiconductor Corporation**  
 1111 West Bardin Road  
 Arlington, TX 76017  
 Tel: 1(800) 272-9959  
 Fax: 1(800) 737-7018

**National Semiconductor Europe**  
 Fax: (+49) 0-180-530 85 86  
 Email: cnjwge@tevm2.nsc.com  
 Deutsch Tel: (+49) 0-180-530 85 85  
 English Tel: (+49) 0-180-532 78 32  
 Français Tel: (+49) 0-180-532 93 58  
 Italiano Tel: (+49) 0-180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
 19th Floor, Straight Block,  
 Ocean Centre, 5 Canton Rd.  
 Tsimshatsui, Kowloon  
 Hong Kong  
 Tel: (852) 2737-1600  
 Fax: (852) 2736-9960

**National Semiconductor Japan Ltd.**  
 Tel: 81-043-299-2309  
 Fax: 81-043-299-2408

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.

This datasheet has been downloaded from:

[www.DatasheetCatalog.com](http://www.DatasheetCatalog.com)

Datasheets for electronic components.

# National Semiconductor was acquired by Texas Instruments.

[http://www.ti.com/corp/docs/investor\\_relations/pr\\_09\\_23\\_2011\\_national\\_semiconductor.html](http://www.ti.com/corp/docs/investor_relations/pr_09_23_2011_national_semiconductor.html)

This file is the datasheet for the following electronic components:

DS8880J - <http://www.ti.com/product/ds8880j?HQS=TI-null-null-dscatalog-df-pf-null-wwe>

DS7880J - <http://www.ti.com/product/ds7880j?HQS=TI-null-null-dscatalog-df-pf-null-wwe>

DS8880N - <http://www.ti.com/product/ds8880n?HQS=TI-null-null-dscatalog-df-pf-null-wwe>