National Semiconductor

Display Controllers/Drivers

DS8887 8-Digit High Voltage Anode Driver (Active-High Inputs)
DS7889/DS8889 8-Segment High Voltage Cathode Driver (Active-High Inputs)
DS7897A/DS8897A 8-Digit High Voltage Anode Driver (Active-Low Inputs)

General Description

The DS8887 and DS7897A/DS8897A are designed to drive the individual anodes of a 7-segment (cathodes) high-voltage gas discharge panel in a time multiplexed fashion.

When driven with appropriate input signals, the driver will switch voltage and impedance levels at the anode. This will allow or prevent ionization of gas around selected cathode in order to form a numeric display. This main application is to interface with MOS outputs (fully-decoded) and the anodes of a gas-discharge panel, since the devices can source up to 16 mA at a low impedance and can tolerate more than 55V in the "OFF" state.

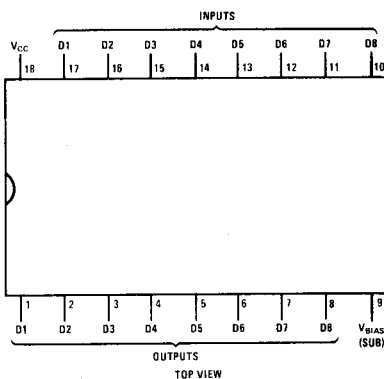DS7889/DS8889 is capable of driving 8 segments of a high-voltage display tube with a constant output sink current, which can be adjusted by external program resistor, R_P. The program current is half that of output "ON" current. In the "OFF" state the outputs can tolerate more than 80V. The ratio of "ON" output currents is within ±10%. Inputs have negative clamp diodes. Active high input logic. The main application of the device is to interface MOS circuits to high-voltage displays. Unused outputs should have corresponding inputs connected to V_{EE}.

Features

- Versatile circuits for a wide range of display applications
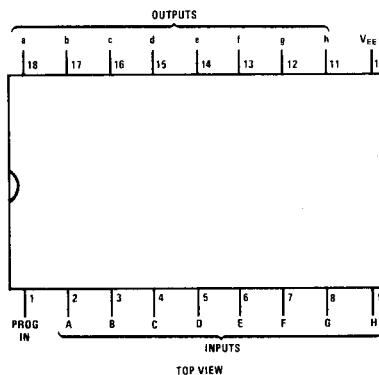- High breakdown voltages
- Low power dissipation

Connection Diagrams (dual-in-line packages)

DS8887, DS7897/DS8897

INPUTS

| V_{CC} 18 | D1 17 | D2 16 | D3 15 | D4 14 | D5 13 | D6 12 | D7 11 | D8 10 |

| D1 1 | D2 2 | D3 3 | D4 4 | D5 5 | D6 6 | D7 7 | D8 8 | V_{BIAS} (SUB) 9 |

OUTPUTS

TOP VIEW

Order Number DS7897AJ, DS8887J, DS8897AJ or DS8897AN
See NS Package J18A or N18A

DS7889/DS8889

OUTPUTS

| a 18 | b 17 | c 16 | d 15 | e 14 | f 13 | g 12 | h 11 | V_{EE} 10 |

| PROG IN 1 | A 2 | B 3 | C 4 | D 5 | E 6 | F 7 | G 8 | H 9 |

INPUTS

TOP VIEW

Order Number DS7889J, DS8889J or DS8889N
See NS Package J18A or N18A

Absolute Maximum Ratings (Note 1)

Supply Voltage (V_{CC} – V_{BIAS}) (Note 2)
DS8887, DS7897A, DS8897A −60V
Input Voltage
DS8887, DS7897A/DS8897A −20V
DS7899/DS8889 (Note 3) 35V
Output Voltage
DS8887, DS7897A/DS8897A −65V
DS7889/DS8889 85V
Storage Temperature Range −65°C to +150°C
DS7889/DS8889 Maximum Power Dissipation* at 25°C
Cavity Package 1436 mW
Molded Package 1563 mW
DS8887, DS7897A/DS8897A Maximum Power Dissipation† at 25°C
Cavity Package 1496 mW
Molded Package 1714 mW
Lead Temperature (Soldering, 10 seconds) 300°C

Operating Conditions

	MIN	MAX	UNITS
Supply Voltage (V_{CC} – B_{BIAS})			
DS8887, DS7897A/DS8897A	−40	−60	V
Temperature (T_A)			
DS7889, DS7897A	−55	+125	°C
DS8897' DS8889, DS8897A	0	+70	°C

*Derate cavity package 11.49 mW/°C above 25°C; derate molded package 12.5 mW/°C above 25°C.

†Derate cavity package 11.97 mW/°C above 25°C; derate molded package 13.71 mW/°C above 25°C.

Electrical Characteristics (Notes 2, 3 and 4)

	PARAMETER	CONDITIONS			MIN	TYP	MAX	UNITS
DS8887, DS8897A, DS7897A								
V_{IH}	Logical "1" Input Voltage	$V_{OUT} = -1.4V$, $I_{OUT} = -16$ mA, DS8887			−2.0			V
V_{IL}	Logical "0" Input Voltage	$V_{OUT} = -60V$, $I_{OUT} = -100\mu A$, DS8887					−5.5	V
I_{IH}	Logical "1" Input Current	$V_{OUT} = -1.4V$, $I_{OUT} = -16$ mA, DS8897A, DS7897A			−300			μA
I_{IL}	Logical "0" Input Current	$V_{OUT} = -60V$, $I_{OUT} = -100\mu A$, DS8897A, DS7897A					−10	μA
I_I	Input Current	DS8887	$V_{IN} = -1.0V$			335	550	μA
			$V_{IN} = -6.0V$			−0.2	−25	μA
			$V_{IN} = -12V$		−0.10		−0.65	mA
		DS7897A, DS8897A, $V_{IN} = -12V$			−0.45		−1.5	mA
$V_{OUT\ OFF}$	Output "OFF" Voltage	$I_{OUT} = -100\mu A$, $I_{IN} = 0\mu A$			−60	−77		V
$I_{OUT\ OFF}$	Output "OFF" Current	$V_{OUT} = -55V$, $I_{IN} = 0\mu A$				−0.03	−5.0	μA
$V_{OUT\ ON}$	Output "ON" Voltage	$I_{OUT} = -16$ mA	$V_{IN} = -2.0V$, DS8887			−1.0	−1.4	V
			$I_{IN} = -300\mu A$; DS8897A, DS7897A				−1.4	V
I_{BIAS}	V_{BIAS} Current	$I_{OUT} = -16$ mA, $V_{BIAS} = -60V$	$V_{IN} = -1.0V$, DS8887, (Note 5)			−2.2	−4.0	mA
			$I_{IN} = -300\mu A$, DS8897A, DS7897A (One Driver Only)				−1.0	mA
DS7889/DS8889								
I_I	Input Current	$V_{IN} = 6.0V$			150	250	350	μA
I_{IL}	Logical "0" Input Current	$I_{OUT} = 5.0\mu A$, $V_{OUT} = 75V$					7.0	μA
I_{IH}	Logical "1" Input Current	$I_{OUT} = 1.4$ mA, $I_{IP} = 850\mu A$, $V_{OUT} = 50V$			80			μA
V_I	Input Clamp Voltage	$I_{IN} = -1.0$ mA, $T_A = 25°C$				−0.68	−0.85	V
V_{OH}	Output Breakdown Voltage	$I_{OUT} = 100\mu A$, $I_{IN} = 0\mu A$			80			V
I_{CEX}	Output Leakage Current	$V_{OUT} = 75V$, -0.1 mA $\leq I_{IN} \leq 7.0\mu A$				0.02	5.0	μA
I_{PROG}	Prog. Input Voltage	$I_{IP} = 150\mu A$			1.8	2.3		V
		$I_{IP} = 850\mu A$				4.0	4.5	V
I_{OL}	Logical "0" Output Current	$V_{OUT} = 50V$, $80\mu A \leq I_{IN} \leq I_{IP}$	$I_{IP} = 150\mu A$	DS7889	210	300	390	μA
				DS8889	240	300	360	μA
			$I_{IP} = 400\mu A$	DS7889	660	800	940	μA
				DS8889	680	800	920	μA
			$I_{IP} = 850\mu A$	DS7889	1.45	1.7	1.95	mA
				DS8889	1.53	1.7	1.87	mA
$\triangle I_O$	Output Current Ratio	I_{OUT} b Ref = 1.7 mA, $V_{OUT} = 50V$			0.9	1.0	1.1	

Switching Characteristics $T_A = 25°C$ unless otherwise specified.

PARAMETER		CONDITIONS	MIN	TYP	MAX	UNITS
DS8887						
t_{ON}	Propagation Delay from Input to Output "ON"	(See ac Test Circuit and Switching Time Waveforms)			5.0	μs
t_{RISE}	Propagation Delay from Input to Output "ON"	(See ac Test Circuit and Switching Time Waveforms)			1.0	μs
DS7889/DS8889						
t_{pd0}	Propagation Delay to a Logical "0" from Input to Output	$R_P = 6.0k$ to $6.0V$, $R_{OUT} = 1.0k$ to $6.0V$		37	100	ns
t_{pd1}	Propagation Delay to a Logical "1" from Input to Output	Input Ramp Rate ≤ 15 ns, Freq = 1.0 MHz dc = 50%, Amplitude = 6.0V		92	200	ns

Note 1: "Absolute Maximum Ratings" 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: All voltage shown for DS8887, DS7897A/DS8897A W.R.T. $V_{CC} = 0V$. All currents into device pins shown as positive, out of device pins as negative. All values shown as max or min on absolute basis.

Note 3: All voltages for DS7889/DS8889 with respect to $V_{EE} = 0V$.

Note 4: Unless otherwise specified min/max limits apply across the $-55°C$ to $+125°C$ temperature range for the DS7889 and DS7897A, and across the $0°C$ to $+70°C$ range for the DS8887, DS8889 and DS8897A. All typicals are given for $T_A = 25°C$.
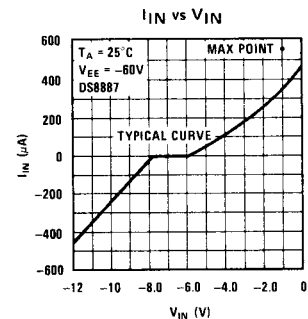
Note 5: Supply currents specified for any one input = $-1.0V$. All other inputs = $-5.5V$ and selected output having 16 mA load.
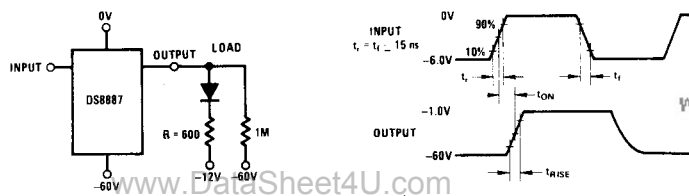
Typical Application
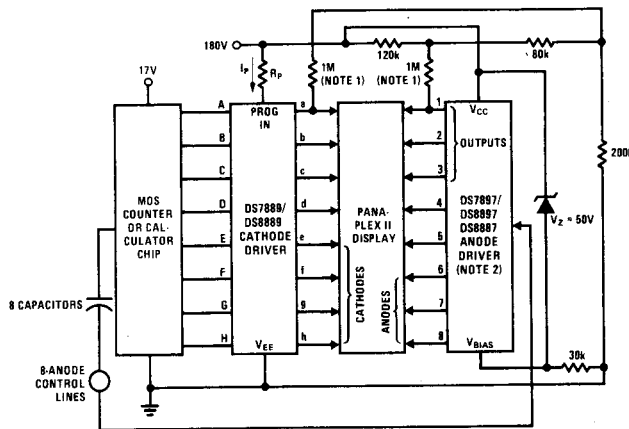
Note 1: All outputs of both cathode and anode driver have loads as shown for output a and digit 1.
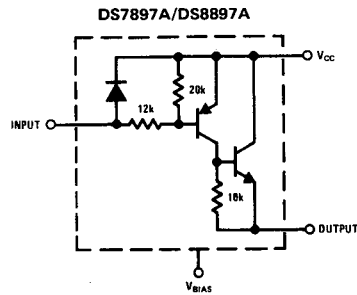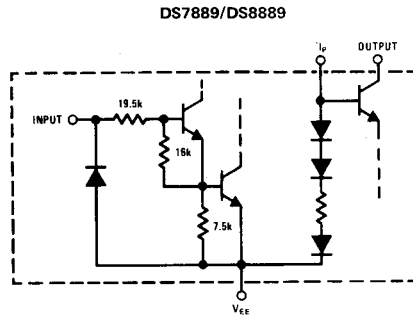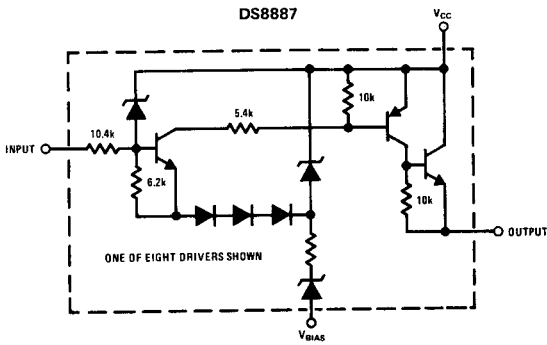Note 2: Use DS8887 for active-high inputs and DS8897 for active-low inputs.

Typical Performance Characteristics

I_{IN} vs V_{IN}

AC Test Circuit and Switching Time Waveforms

Logic Diagrams

DS8887

ONE OF EIGHT DRIVERS SHOWN

DS7889/DS8889

DS7897A/DS8897A