

## 8-CHANNEL SOURCE DRIVER WITH OVER-CURRENT PROTECTION

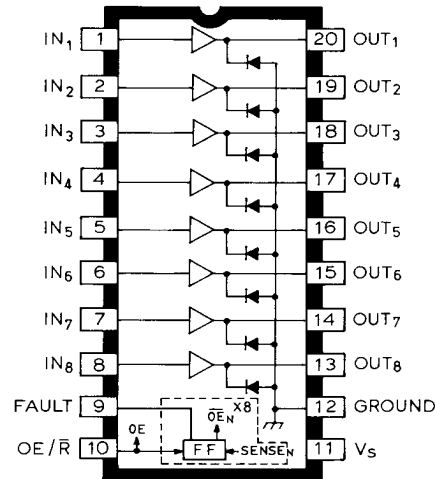
### FEATURES

- 350 mA Output Source Current
- Over-Current Protected
- Internal Ground Clamp Diodes
- Output Breakdown Voltage 35 V, Minimum
- TTL, DTL, PMOS, or CMOS Compatible Inputs
- Internal Thermal Shutdown

Providing over-current protection for each of its eight sourcing outputs, the UDN-2987A driver is used as interface between standard low-level logic and relays, motors, solenoids, LEDs and incandescent lamps. The device includes thermal shutdown and output transient protection/clamp diodes for use with sustaining voltages to 35 V.

In this driver, each channel includes a latch to turn OFF that channel if the maximum channel current is exceeded. All channels are disabled if the thermal shutdown is activated. A common FAULT output is used to indicate either chip thermal shutdown or any over-current condition. All outputs are enabled by pulling the common OE/R input high. When OE/R is low, all outputs are inhibited and the eight latches are reset. The UDN-2987A is supplied in a 20-lead dual in-line plastic package.

Under normal operating conditions each of eight outputs will source in excess of 100 mA continuously at an ambient temperature of 25°C and a supply of 35 V. The over-current fault circuit will protect the device from short-circuits to ground with supply voltages of up to 35 V.



Dwg. No. A-13,285

The inputs are compatible with 5 V and 12 V logic systems—TTL, Schottky TTL, DTL, PMOS, and CMOS. In all cases, the output is switched on by an active high input level.

### ABSOLUTE MAXIMUM RATINGS at $T_A = +25^\circ\text{C}$

Driver Supply Voltage, $V_S$	35 V
Output Sustaining Voltage, $V_{CE(SUS)}$	35 V
Continuous Output Current, $I_{OUT}$	— 500 mA*
FAULT Output Voltage, $V_{CE}$	50 V
FAULT Output Current, $I_C$	30 mA
Input Voltage, $V_{IN}$	15 V
Package Power Dissipation, $P_D$	See Graph
Operating Temperature Range, $T_A$	— 20°C to +85°C
Storage Temperature Range, $T_S$	— 55°C to +150°C

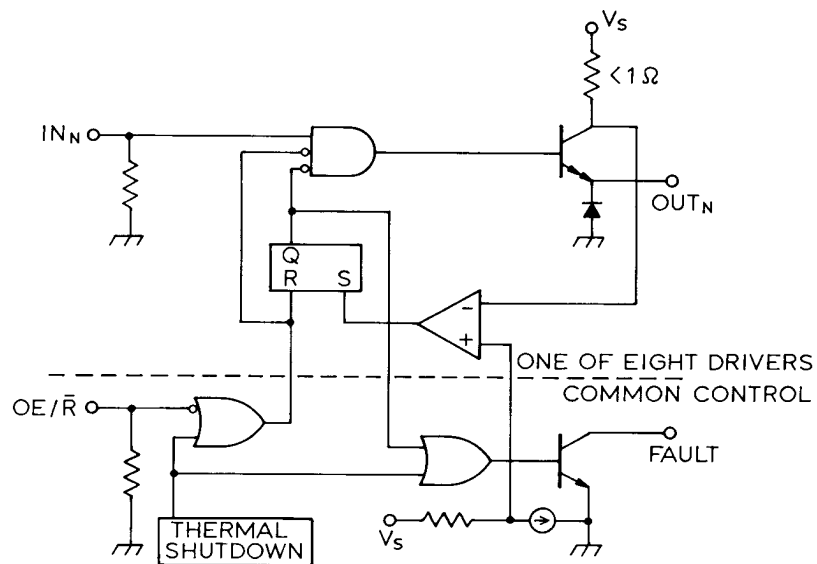
\*Outputs are disabled at approximately — 500 mA per driver.

SPRAGUE DATA SHEET 29310.4

SEMICONDUCTOR GROUP  
**SPRAGUE ELECTRIC COMPANY**

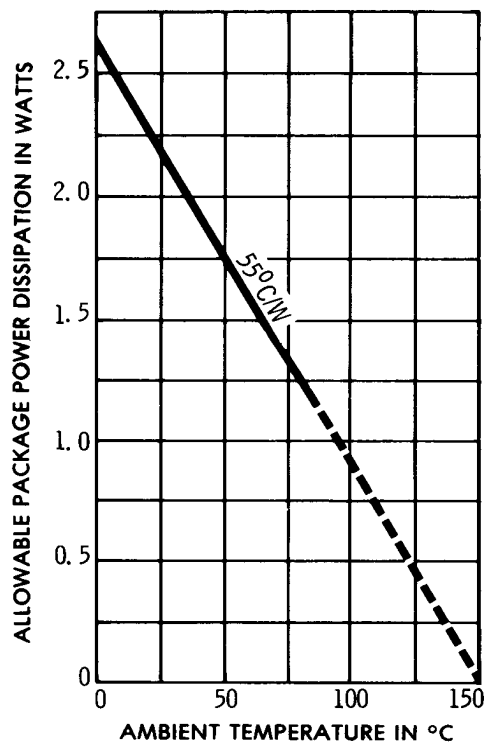
a Unit of The Penn Central Corporation  
 115 Northeast Cutoff, Worcester, MA 01606

FUNCTIONAL  
BLOCK  
DIAGRAM



Dwg. No. A-13,286

ALLOWABLE POWER DISSIPATION  
AS A FUNCTION OF AMBIENT TEMPERATURE



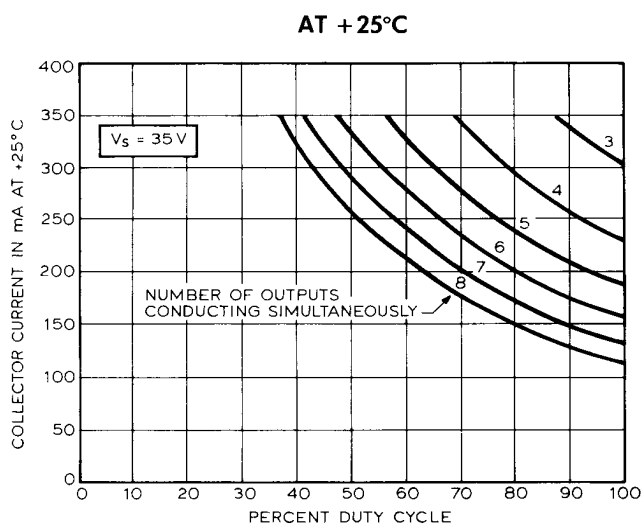
Dwg. No. A-11,112A

**ELECTRICAL CHARACTERISTICS at  $T_A = 25^\circ\text{C}$ ,  $V_{OE} = 2.4\text{ V}$ ,  $V_S = 35\text{ V}$  unless otherwise noted.**

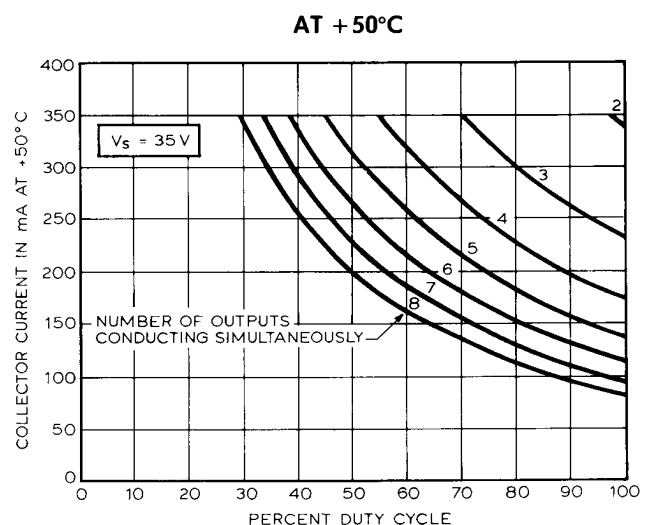
Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Functional Supply Range	$V_S$		7.0	—	35	V
Output Leakage Current	$I_{CEX}$	$V_{IN} = 0.4\text{ V}^*$	—	$< -5$	-200	$\mu\text{A}$
Output Sustaining Voltage	$V_{CE(SUS)}$	$I_{OUT} = -350\text{ mA}$ , $L = 2.0\text{ mH}$	35	—	—	V
Output Saturation Voltage	$V_{OUT(SAT)}$	$V_{IN} = 2.4\text{ V}$ , $I_{OUT} = -100\text{ mA}$	—	1.6	1.8	V
		$V_{IN} = 2.4\text{ V}$ , $I_{OUT} = -225\text{ mA}$	—	1.7	1.9	V
		$V_{IN} = 2.4\text{ V}$ , $I_{OUT} = -350\text{ mA}$	—	1.8	2.0	V
Channel Shutdown Threshold	$I_M$	$V_{IN} = 2.4\text{ V}$	-400	-500	—	mA
FAULT Leakage Current	$I_{CEX}$	$V_{CC} = 35\text{ V}$	—	$< 1.0$	100	$\mu\text{A}$
FAULT Saturation Voltage	$V_{CE(SAT)}$	$I_C = 30\text{ mA}$	—	0.3	0.8	V
Input Voltage	$V_{IN(ON)}$		2.4	—	—	V
	$V_{IN(OFF)}$		—	—	0.4	V
Input Current	$I_{IN(ON)}$	$V_{IN} = 2.4\text{ V}$	—	125	170	$\mu\text{A}$
		$V_{IN} = 5.0\text{ V}$	—	840	1020	$\mu\text{A}$
		$V_{IN} = 12\text{ V}$	—	1500	1800	$\mu\text{A}$
	$I_{IN(OFF)}$	$V_{IN} = 0.4\text{ V}$	—	—	15	$\mu\text{A}$
Clamp Diode Leakage Current	$I_R$	$V_R = 35\text{ V}$ , $T_A = 70^\circ\text{C}$	—	—	50	$\mu\text{A}$
Clamp Diode Forward Voltage	$V_F$	$I_F = 350\text{ mA}$	—	1.5	1.8	V
Supply Current	$I_{S(ON)}$	$V_{IN} = 2.4\text{ V}^*$ , Outputs Open	—	13	18	mA
	$I_{S(OFF)}$	$V_{IN} = 0.4\text{ V}^*$	—	8.0	12	mA
Thermal Shutdown	$T_J$		—	165	—	$^\circ\text{C}$
Thermal Hysteresis	$T_J$		—	15	—	$^\circ\text{C}$
Propagation Delay Time	$t_{PLH}$	$R_L = 100\Omega$	—	0.3	0.6	$\mu\text{s}$
	$t_{PHL}$	$R_L = 100\Omega$	—	2.0	4.0	$\mu\text{s}$
Dead Time	$t_d$		—	1.0	—	$\mu\text{s}$

\*All inputs simultaneously.

**ALLOWABLE OUTPUT CURRENT  
AS A FUNCTION OF DUTY CYCLE**



Dwg. No. A-13.288



Dwg. No. A-13.289

## APPLICATIONS INFORMATION AND CIRCUIT DESCRIPTION

As with all power integrated circuits, the UDN-2987A has a maximum allowable output current rating. The 500 mA rating does not imply that operation at that value is permitted or even obtainable. The channel output current trip point is specified as  $-400$  mA, minimum; therefore, attempted operation at current levels greater than  $-400$  mA may cause a fault indication and channel shutdown. The device is tested at a maximum of  $-350$  mA and that is the recommended maximum output current per driver. It provides protection for current overloads or shorted loads up to 35 V.

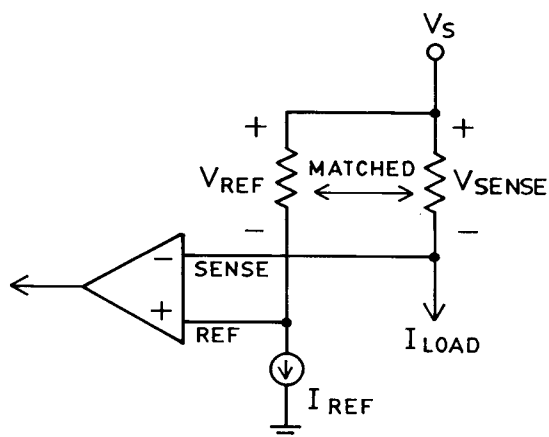
All outputs are enabled by pulling the OE/R input high. When OE/R is low or allowed to float (internal pull-down), all outputs are inhibited and the latches are reset. The latches are also reset during power-up, regardless of the state of the OE/R input.

The load current causes a small voltage drop across the internal low-value sense resistor. This voltage is compared to the voltage drop across a reference resistor with a constant current. The two resistors are matched to eliminate errors due to manufacturing tolerances or temperature effects. Each channel includes a comparator and its own latch. An over-current fault ( $V_{\text{SENSE}} > V_{\text{REF}}$ ) will set the affected latch and shut down only that channel. All other channels will continue to operate normally. The latch includes a  $1\text{ }\mu\text{s}$  delay ( $t_d$ ) to prevent unwanted triggering due to crossover currents generated when switching inductive loads. For an abrupt short circuit, the delay and output switching times will allow a brief, permissible current in excess of the trip current before the output driver is turned OFF.

A common thermal shutdown disables all outputs if the chip temperature exceeds  $+165^\circ\text{C}$ . At thermal shutdown, all latches are reset. The outputs are disabled until the chip cools down to about  $+150^\circ\text{C}$  (thermal hysteresis).

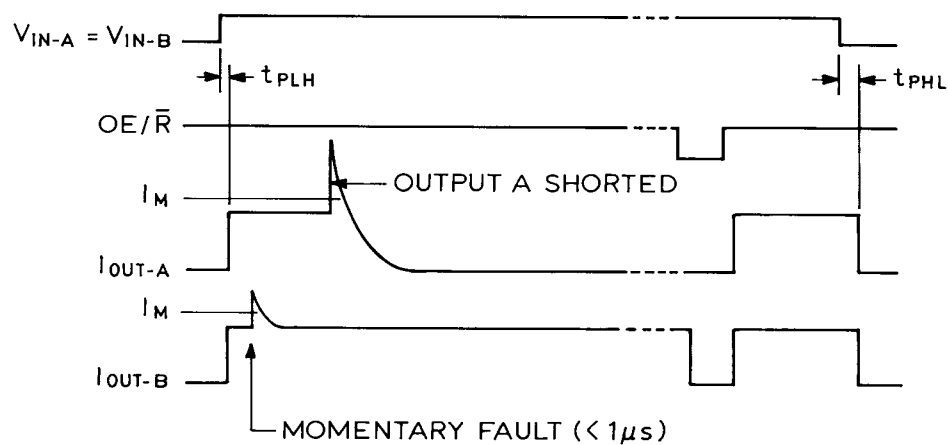
A common open-collector FAULT output is used to indicate any channel over-current condition or chip thermal shutdown.

# OVER-CURRENT FAULT SENSE



Dwg. No. A-13,292

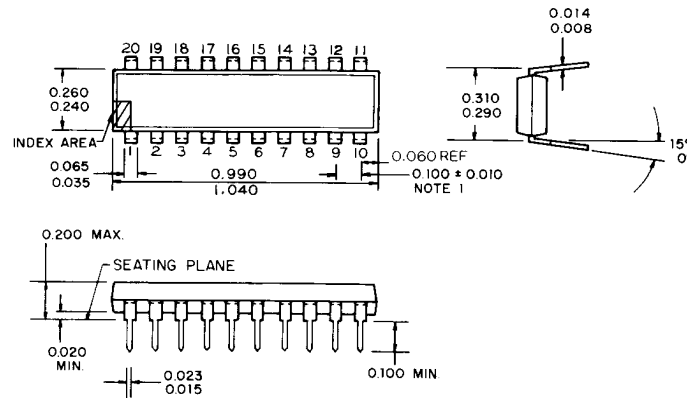
# OUTPUT CURRENT WAVESHAPES



Dwg. No. A-13,293

**UDN-2987A**  
**8-CHANNEL SOURCE DRIVER**

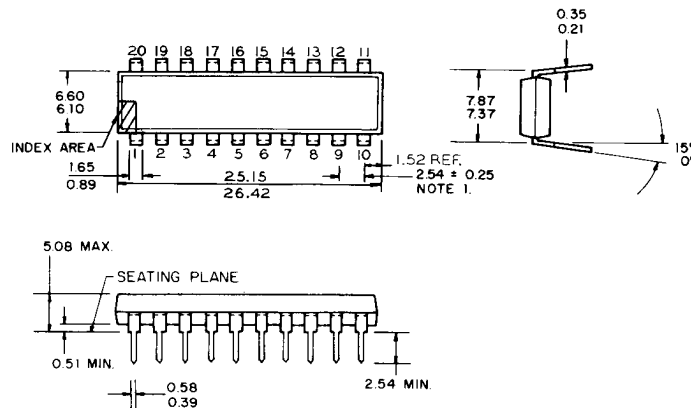
**DIMENSIONS IN INCHES**



Dwg. No. A-10,430A IN

**DIMENSIONS IN MILLIMETERS**

Based on 1" = 25.4 mm



Dwg. No. A-10,430A MM

In the construction of the components described, the full intent of the specification will be met. The Sprague Electric Company, however, reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the design of its products. Components made under military approvals will be in accordance with the approval requirements.

The information included herein is believed to be accurate and reliable. However, the Sprague Electric Company assumes no responsibility for its use, nor for any infringements of patents or other rights of third parties which may result from its use.

**NOTES:**

1. Lead spacing tolerance is non-cumulative.
2. Exact body and lead configuration at vendor's option within limits shown.
3. Lead gauge plane is 0.030" (0.76 mm) max. below seating plane.