Integrated Circuits

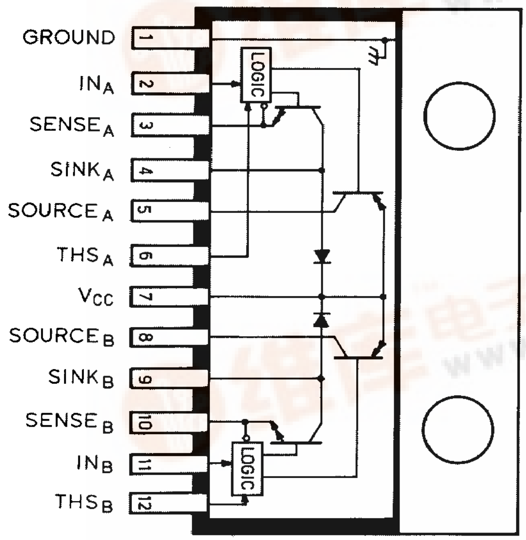
UDN2966W

DATA SHEET 29319.14

IECQ MFG. APPROVAL

DUAL SOLENOID DRIVER WITH PWM CURRENT CONTROL

UDN2966W



Dwg. PP-024

Rated for continuous operation to 4.8 A and 65 V per channel, the UDN2966W is designed to drive impact printer solenoids. Each of the two independent driver pairs in the UDN2966W include input gain and level shifting, a voltage regulator for single-supply operation, pulse-width modulated (PWM) output-current control, a flyback diode, and on-chip thermal protection. The inputs are compatible with TTL, LSTTL, and low-voltage CMOS or PMOS logic.

The PWM mode helps maximize load efficiency. Output current, threshold voltage, and hysteresis are set by the user's selection of external resistors. At the specified output current trip level, the source driver turns OFF, allowing the load current to decay through the sink driver and an external ground clamp diode. When the lower current trip point is reached, the source driver is turned back ON.

For maximum power-handling capability, the UDN2966W is supplied in a 12-pin single in-line power tab package. An external heat sink is required for most high-current applications. The tab is at ground potential and needs no insulation.

FEATURES

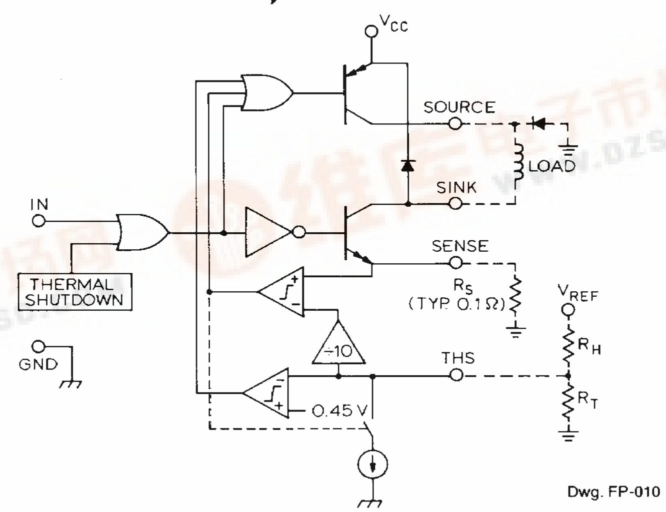
- 5 A Peak Output Current
- 65 V Output Sustaining Voltage
- Internal Flyback Diodes
- Internal Current Control
- Internal Thermal Shutdown Circuitry

ABSOLUTE MAXIMUM RATINGS at $T_J \leq +150°C$

Supply Voltage, V_{CC} . . . . 65 V
Peak Output Current, I_{OUT} . . . . ±5.0 A
Input Voltage Range,
V_{IN} . . . . −0.3 V to +7.0 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

Output current rating may be limited by duty cycle, ambient temperature, and heat sinking. Under any set of conditions, do not exceed the specified peak output current or a junction temperature of +150°C.

FUNCTIONAL BLOCK DIAGRAM (ONE OF TWO DRIVERS)



Dwg. FP-010

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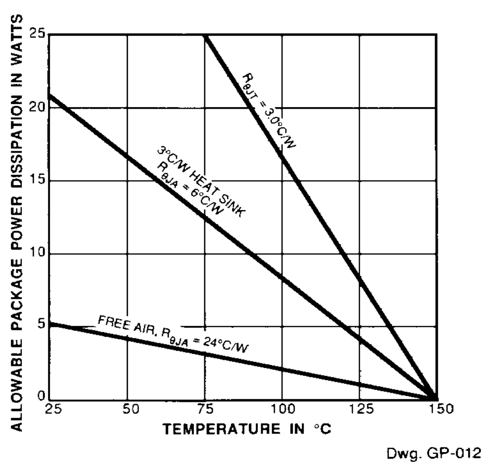
ELECTRICAL CHARACTERISTICS at T_A = +25°C, T_J ≤ +150°C, V_{CC} = 65 V, V_{SENSE} = 0 V (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			Units
			Min.	Typ.	Max.	
Supply Voltage Range	V_{CC}	Operating	20	–	65	V
Output Drivers						
Output Leakage Current	I_{CEX}	Sink Driver, V_{IN} = 2.4 V, V_{OUT} = 65 V	–	<10	100	µA
		Source Driver, V_{IN} = 2.4 V, V_{OUT} = 0 V	–	<–10	–100	µA
Output Saturation Voltage	$V_{CE(SAT)}$	Sink Driver, I_{OUT} = +4.8 A	–	2.3	2.5	V
		Source Driver, I_{OUT} = –4.8 A	–	2.7	2.9	V
Output Sustaining Voltage	$V_{CE(sus)}$	I_{OUT} = ±4.8 A, L = 3.5 mH	65	–	–	V
Clamp Diode Forward Volt.	V_F	I_F = 4.8 A	–	–	3.0	V
Output Rise Time	t_r	I_{LOAD} = 4.0 A, 10% to 90%, Resistive Load	–	0.5	1.0	µs
Output Fall Time	t_f	I_{LOAD} = 4.0 A, 90% to 10%, Resistive Load	–	0.5	1.0	µs
Control Logic						
Logic Input Voltage	$V_{IN(1)}$		2.4	–	–	V
	$V_{IN(0)}$		–	–	0.8	V
Logic Input Current	$I_{IN(1)}$	V_{IN} = 2.4 V	–	–150	–200	µA
	$I_{IN(0)}$	V_{IN} = 0.8 V	–	–150	–200	µA
	$I_{THS(OFF)}$	V_{THS} ≤ 400 mV	–	–60	–	µA
	$I_{THS(ON)}$	V_{THS} ≥500 mV, V_{SENSE} ≤ V_{THS}/10.5	–	-2.0	–	µA
	$I_{THS(HYS)}$	V_{SENSE} ≥ V_{THS}/9.5, V_{THS} = 0.6 V to 5.0 V	140	200	260	µA
Output Disable Voltage	$V_{THS(OFF)}$		–	–	400	mV
V_{THS}/V_{SENSE} Ratio	–	At Trip Point, V_{THS} = 2.0 V to 5.0 V	9.5	10	10.5	–
Supply Current (Total Device)	I_{CC}	V_{IN} = 2.4 V, Outputs OFF	–	10	15	mA
		V_{IN} = 0.8 V, Outputs Open	–	28	32	mA
Propagation Delay Time (resistive Load)	t_{pd}	50% V_{IN} to 50% V_{OUT}, Turn OFF	–	–	3.0	µs
		50% V_{IN} to 50% V_{OUT}, Turn ON	–	–	3.0	µs
		100% V_{SENSE} to 50% V_{OUT}*	–	–	3.0	µs
Thermal Shutdown Temp.	T_J		–	175	–	°C

Typical Data is for design information only.
Negative current is defined as coming out of (sourcing) the specified device pin.
*Where V_{SENSE} ≥ V_{THS}/9.5

TRUTH TABLE

V_{IN}	V_{THS}	V_{SENSE}	Source Driver	Sink Driver	Function
High	NA	NA	OFF	OFF	OFF
Low	<0.4V	NA	OFF	ON	OFF
Low	0.6 V to 5.0 V	<V_{THS}/10	ON	ON	ON
Low	0.6 V to 5.0 V	>V_{THS}/10	OFF	ON	Chopping



Dwg. GP-012

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DUAL SOLENOID DRIVER WITH PWM CURRENT CONTROL

CIRCUIT DESCRIPTION AND APPLICATIONS INFORMATION

The UDN2966W high-current driver is intended for use as a free-running, pulse-width modulated solenoid driver.

Circuit Description. In operation, the source and sink drivers are both turned ON by a low level at the input. The load current rises with time as a function of the load inductance, total circuit resistance, and supply voltage and is sensed by the external sense resistor (R_S). When the load current reaches the trip point (I_{TRIP}), the comparator output goes high and turns OFF the source driver. The actual load current will peak slightly higher than I_{TRIP} because of the internal logic and switching delays.

After the source driver is turned OFF, the load current continues to circulate through the sink driver and an external ground clamp diode. The rate of current decay is a function of the load inductance and total circuit resistance.

An internal constant current sink reduces the trip point (hysteresis) until the decaying load current reaches the lower threshold, when the comparator output goes low and the source driver is again turned ON. Load current is again allowed to rise to the trip point and the cycle repeats.

Maximum load current and hysteresis is determined by the user.

Determining Maximum Load Current and Hysteresis. Trip current (I_{TRIP}) is determined as a function of resistance R_S and the threshold voltage, V_{THS}:

$$I_{TRIP} = \frac{V_{THS}}{10\,R_S}$$

where $V_{THS} = 10 \cdot V_{SENSE} = 0.6$ V to 5.0 V.

Pulling V_{THS} down to less than 0.4 V disables the source driver, turning the load OFF. This method of turn-OFF produces a relatively long current decay as compared with switching the input. When switching the input, both the source and the sink driver are turned OFF, producing a fast current decay.

Hysteresis percentage (H) is determined by resistance R_H and is independent of the load current:

$$H = \frac{R_H}{50 \cdot V_{REF}}$$

The chopping frequency is asynchronous and a function of the system and circuit parameters, including load inductance, supply voltage, hysteresis setting, and switching speed of the driver.

Resistance R_T is determined as:

$$R_T = \frac{R_H\, V_{THS}}{V_{REF} - V_{THS}}$$

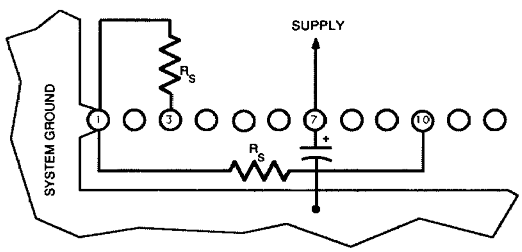
Note that if $V_{THS} = V_{REF}$, then $R_T = \infty$.

External ground clamp power diodes are required at the source outputs (pins 5 and 8) for proper driver operation. To minimize power dissipation due to switching losses, these diodes should have a fast recovery time.

Circuit Layout. To prevent interaction between channels, each of the two high-level power ground returns (the low side of the sense resistors) must be returned independently to the low-level signal ground (pin 1). The circuit common (pin 1) can then be routed to the system ground.

The printed wiring board should utilize a heavy ground plane. For optimum performance, the driver should be soldered directly into the board.

The power supply (V_{CC}) should be decoupled with an electrolytic capacitor ($\geq$10 μF) as close as possible to pin 7.



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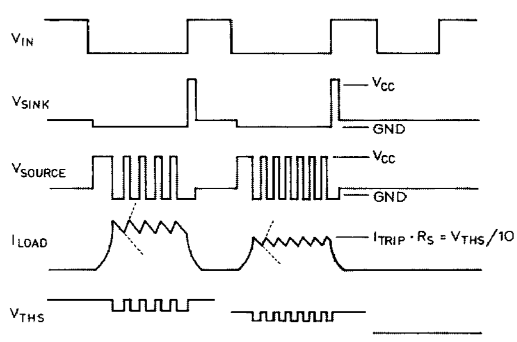
TYPICAL WAVESHAPES



Dwg. WP-006

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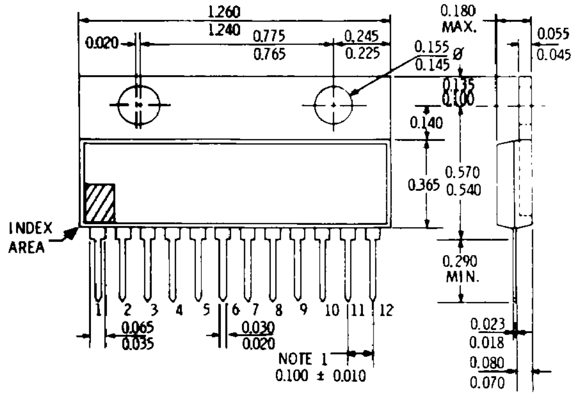
PLASTIC SINGLE IN-LINE POWER TAB

DIMENSIONS IN INCHES



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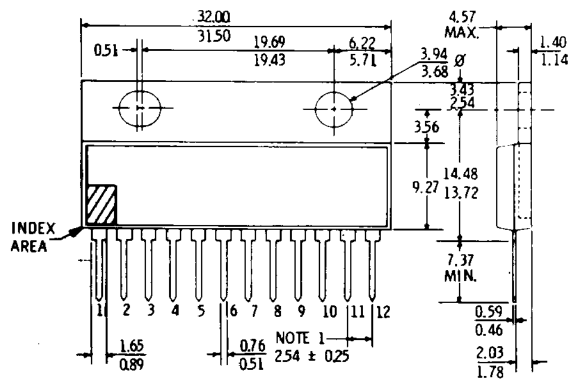
DIMENSIONS IN MILLIMETERS
(Based on 1″ = 25.40 mm)



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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 in. (0.76 mm) max. below seating plane.

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