2962

DUAL SOLENOID/MOTOR DRIVER
—PULSE-WIDTH MODULATED CURRENT CONTROL

GROUND — 1
IN$_A$ — 2
SENSE$_A$ — 3
SINK$_A$ — 4
SOURCE$_A$ — 5
THS$_A$ — 6
V$_{CC}$ — 7
SOURCE$_B$ — 8
SINK$_B$ — 9
SENSE$_B$ — 10
IN$_B$ — 11
THS$_B$ — 12

LOGIC

Dwg. No. D-1001

Using PWM to minimize power dissipation and maximize load efficiency, the UDN2962W dual driver is recommended for impact printer solenoids and stepper motors. It is comprised of two source/sink driver pairs rated for continuous operation to ±3 A. It can be connected to drive two independent loads or a single load in the full-bridge configuration. Both drivers include output clamp/flyback diodes, input gain and level shifting, a voltage regulator for single-supply operation, and pulse-width modulated output-current control circuitry. Inputs are compatible with most TTL, DTL, LSTTL, and low-voltage CMOS or PMOS logic.

The peak output current and hysteresis for each source/sink pair is set independently. 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. The internal clamp diode then allows current to flow without additional input from the power supply. When the lower current trip point is reached, the source driver turns back ON.
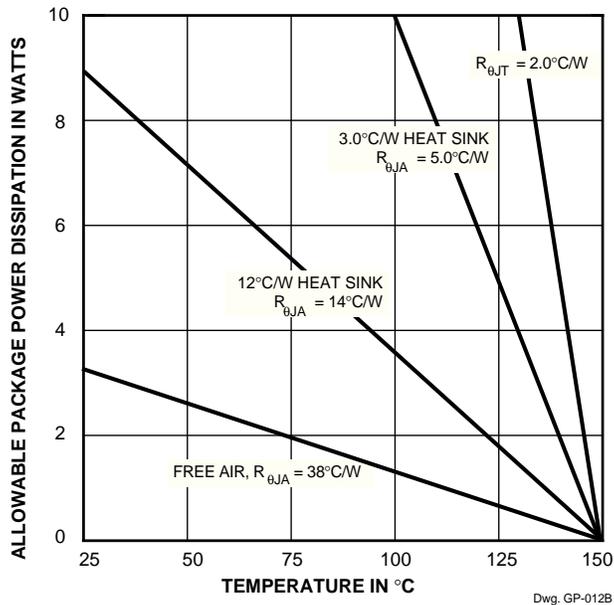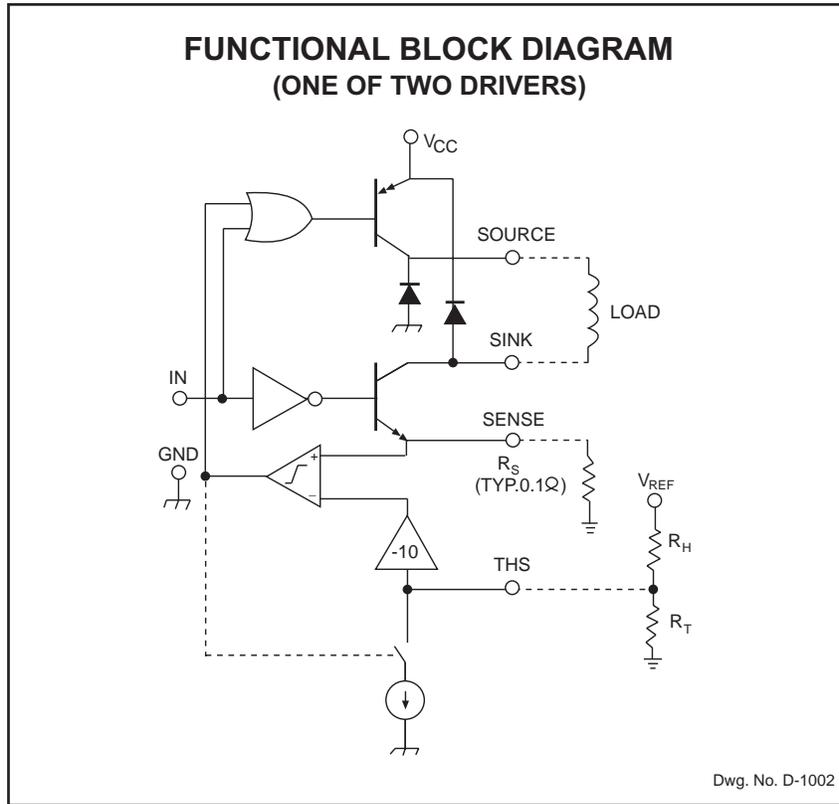
The UDN2962W is in a 12-pin single in-line power-tab package. The tab is at ground potential and needs no insulation. For high-current or high-frequency applications, external heat sinking may be required.

FEATURES

■ 4 A Peak Output
■ 45 V Min. Sustaining Voltage
■ Internal Clamp Diodes
■ TTL/PMOS/CMOS Compatible Inputs
■ High-Speed Chopper

ABSOLUTE MAXIMUM RATINGS
at T$_J$ ≤ +150°C

Supply Voltage, V$_{CC}$ . . . . **45 V**

Peak Output Current, I$_{OUT}$ . . . . **±4 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**

NOTE: 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 current and a junction temperature of +150°C.

Always order by complete part number: **UDN2962W** .

Allegro® MicroSystems, Inc.

FUNCTIONAL BLOCK DIAGRAM
(ONE OF TWO DRIVERS)

V_CC
SOURCE
LOAD
SINK
IN
SENSE
GND
R_S
(TYP.0.1Ω)
V_REF
R_H
-10
THS
R_T

Dwg. No. D-1002

TRUTH TABLE

V_{IN}	V_{SENSE}	SOURCE DRIVER	SINK DRIVER
High	NA	Off	Off
Low	$<V_{THS}/10$	On	On
Low	$>V_{THS}/10$	Off	On

ALLOWABLE PACKAGE POWER DISSIPATION IN WATTS

$R_{\theta JT}$ = 2.0°C/W

3.0°C/W HEAT SINK
$R_{\theta JA}$ = 5.0°C/W

12°C/W HEAT SINK
$R_{\theta JA}$ = 14°C/W

FREE AIR, $R_{\theta JA}$ = 38°C/W

TEMPERATURE IN °C

Dwg. GP-012B

Allegro®
MicroSystems, Inc.

ELECTRICAL CHARACTERISTICS at T_A = +25°C, $T_J \leq$ +150°C, V_{CC} = 45 V, V_{SENSE} = 0 V (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Supply Voltage Range	V_{CC}	Operating	20	—	45	V
Output Drivers						
Output Leakage Current	I_{CEX}	V_{IN} = 2.4 V, V_{SOURCE} = 0 V	—	<-1.0	-100	µA
		V_{IN} = 2.4 V, V_{SINK} = 45 V	—	<1.0	100	µA
Output Saturation Voltage	$V_{CE(SAT)}$	Source Drivers, I_{LOAD} = 3.0 A	—	2.1	2.3	V
		Source Drivers, I_{LOAD} = 1.0 A	—	1.7	2.0	V
		Sink Drivers, I_{LOAD} = 3.0 A	—	1.7	2.0	V
		Sink Drivers, I_{LOAD} = 1.0 A	—	1.1	1.3	V
Output Sustaining Voltage	$V_{CE(sus)}$	I_{OUT} = ±3.0 A, L = 3.5 mH	45	—	—	V
Output Current Regulation	ΔI_{OUT}	V_{THS} = 0.6 V to 1.0 V, L = 3.5 mH	—	—	±25	%
		V_{THS} = 1.0 V to 2.0 V, L = 3.5 mH	—	—	±10	%
		V_{THS} = 2.0 V to 5.0 V, L = 3.5 mH	—	—	±5.0	%
Clamp Diode Forward Voltage	V_F	I_F = 3.0 A	—	1.7	2.0	V
Output Rise Time	t_r	I_{LOAD} = 3.0 A, 10% to 90%, Resistive Load	—	0.5	1.0	µs
Output Fall Time	t_f	I_{LOAD} = 3.0 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	—	1.0	10	µA
	$I_{IN(0)}$	V_{IN} = 0.8 V	—	-20	-100	µA
	$I_{THS(ON)}$	$V_{THS} \geq$ 500 mV, $V_{SENSE} \leq V_{THS}$/10.5	—	-2.0	—	µA
	$I_{THS(HYS)}$	$V_{SENSE} \geq V_{THS}$/9.5, V_{THS} = 0.6 V to 5.0 V	140	200	260	µA
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	—	8.0	12	mA
		V_{IN} = 0.8 V, Outputs Open	—	25	40	mA
Propagation Delay Time (Resistive Load)	t_{pd}	50% V_{IN} to 50% V_{OUT}, Turn OFF	—	—	2.5	µs
		50% V_{IN} to 50% V_{OUT}, Turn ON	—	—	3.0	µs
		100% V_{SENSE} to 50% V_{OUT}*	—	—	3.0	µs

* Where $V_{SENSE} \geq V_{THS}$/9.5

NOTE: Negative current is defined as coming out of (sourcing) the specified device pin.

CIRCUIT DESCRIPTION
AND APPLICATIONS INFORMATION

The UDN2962W 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 internal 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 $5.0\ V$.

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.
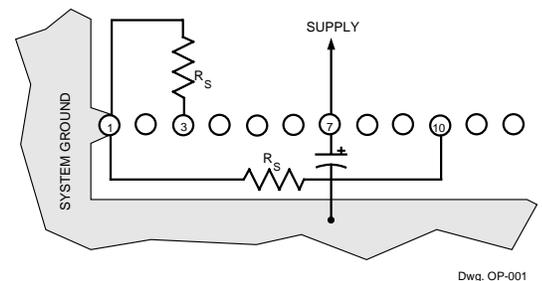
Resistance R_T is determined as:

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

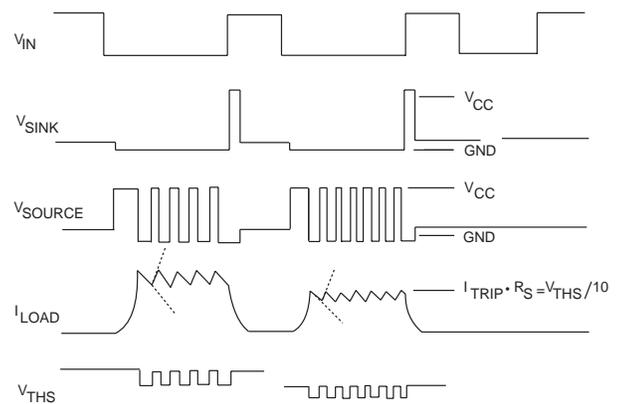Note that if $V_{THS} = V_{REF}$, then $R_T = \infty$.

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 ($\geq 10\ \mu F$) as close as possible to pin 7.
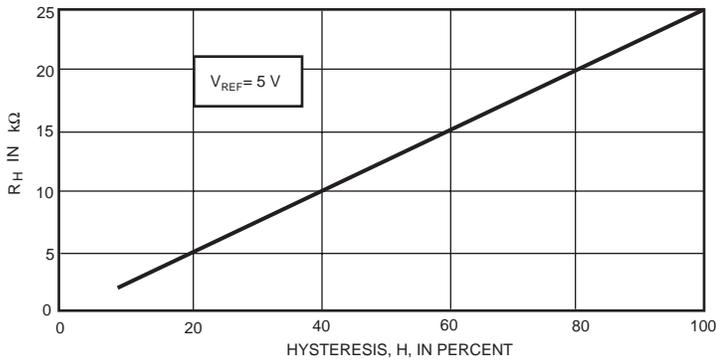

Dwg. OP-001

TYPICAL WAVESHAPES

Dwg. WP-006

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115 Northeast Cutoff, Box 15036
Worcester, Massachusetts 01615-0036 (508) 853-5000
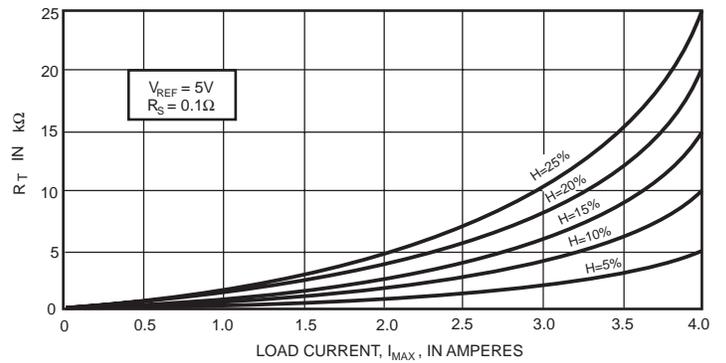
APPLICATIONS INFORMATION

RESISTOR R_H VALUE
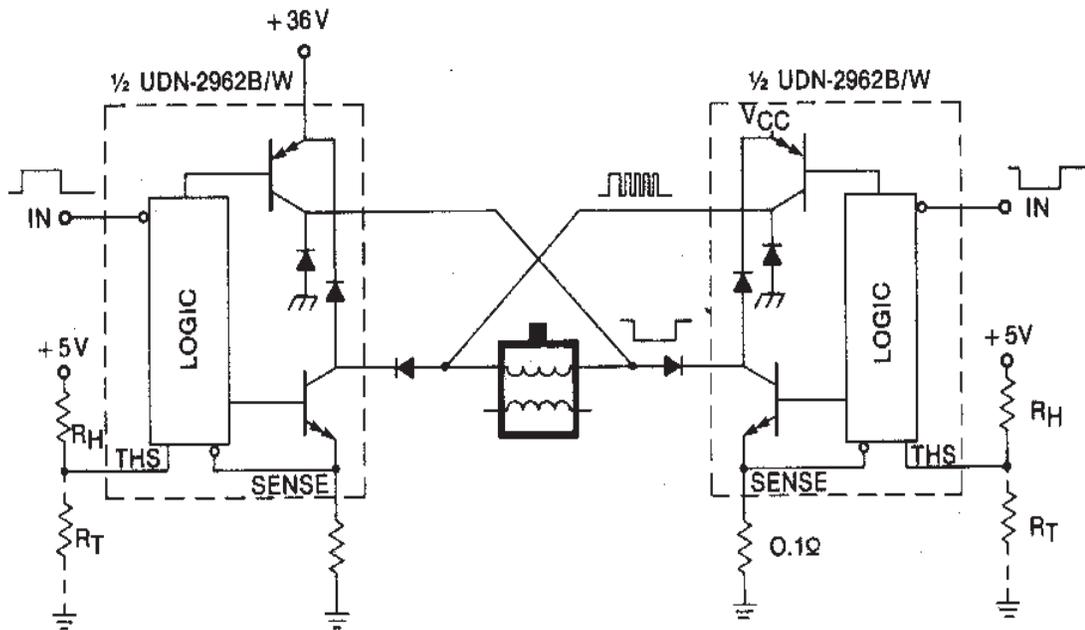### AS A FUNCTION OF HYSTERESIS

Dwg. No. A-12,417

RESISTOR R_T VALUE
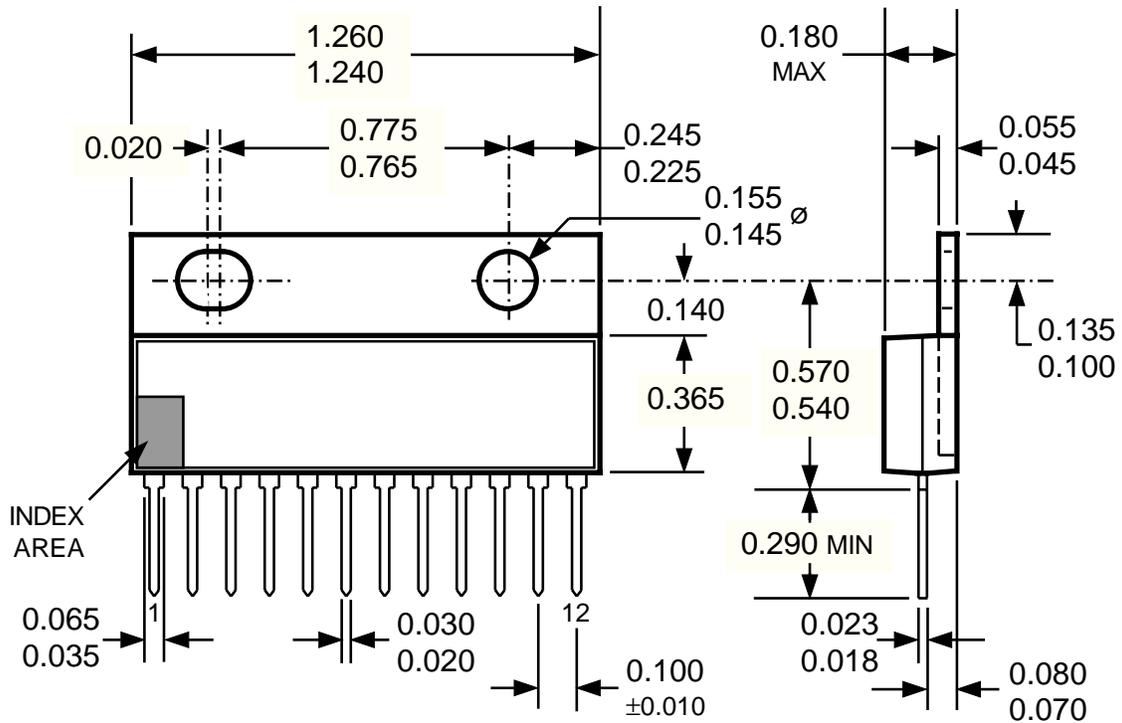### AS A FUNCTION OF PEAK LOAD CURRENT

Dwg. No. A-12,416

Dwg. No. D-1004

R_H AND R_T DETERMINE HYSTERESIS AND PEAK CURRENT

NOTE: Each of the drivers includes an internal logic delay to prevent potentially destructive crossover currents within the driver during phase changes. However, never simultaneously enable both inputs in the full-bridge configurations: A destructive short-circuit to ground will result.

Dimensions in Inches
(controlling dimensions)

1.260
1.240

0.020

0.775
0.765

0.245
0.225

0.155
0.145 Ø

0.140

0.365

INDEX
AREA

0.065
0.035

1

0.030
0.020

12

0.100
±0.010

0.180
MAX

0.055
0.045

0.135
0.100

0.570
0.540

0.290 MIN

0.023
0.018

0.080
0.070

Dwg. MP-007 in

NOTES: 1. Lead thickness is measured at seating plane or below.
2. Lead spacing tolerance is non-cumulative
3. Exact body and lead configuration at vendor's option within limits shown.
4. Lead gauge plane is 0.030" below seating plane.

Dimensions in Millimeters

(for reference only)

32.00
31.49

19.69
19.45

0.51

6.22
5.71

4.57
MAX

1.40
1.14

3.94
3.68 Ø

3.56

9.27

3.43
2.54

14.48
13.71

INDEX
AREA

7.36 MIN

1.65
0.89

1

0.76
0.51

12

2.54
±0.254

0.59
0.45

2.03
1.77

Dwg. MP-007 mm

NOTES: 1. Lead thickness is measured at seating plane or below.
2. Lead spacing tolerance is non-cumulative
3. Exact body and lead configuration at vendor's option within limits shown.
4. Lead gauge plane is 0.762 mm below seating plane.

MOTOR DRIVERS SELECTION GUIDE

Function	Output Ratings *		Part Number †
INTEGRATED CIRCUITS FOR BRUSHLESS DC MOTORS			
3-Phase Controller/Drivers	±2.0 A	45 V	2936 and 2936-120
Hall-Effect Latched Sensors	10 mA	24 V	3175 and 3177
2-Phase Hall-Effect Sensor/Controller	20 mA	25 V	3235
Hall-Effect Complementary-Output Sensor	20 mA	25 V	3275
2-Phase Hall-Effect Sensor/Driver	900 mA	14 V	3625
2-Phase Hall-Effect Sensor/Driver	400 mA	26 V	3626
Hall-Effect Complementary-Output Sensor/Driver	300 mA	60 V	5275
3-Phase Back-EMF Controller/Driver	±900 mA	14 V	8902–A
3-Phase Controller/DMOS Driver	±4.0 A	14 V	8925
3-Phase Back-EMF Controller/Driver	±1.0 A	7 V	8984
INTEGRATED BRIDGE DRIVERS FOR DC AND BIPOLAR STEPPER MOTORS			
PWM Current-Controlled Dual Full Bridge	±750 mA	45 V	2916
PWM Current-Controlled Dual Full Bridges	±1.5 A	45 V	2917 and 2918
PWM Current-Controlled Dual Full Bridge	±750 mA	45 V	2919
Dual Full-Bridge Driver	±2.0 A	50 V	2998
PWM Current-Controlled Full Bridge	±2.0 A	50 V	3952
PWM Current-Controlled Full Bridge	±1.3 A	50 V	3953
PWM Current-Controlled Microstepping Full Bridges	±1.5 A	50 V	3955 and 3957
PWM Current-Controlled Dual Full Bridge	±800 mA	33 V	3964
PWM Current-Controlled Dual Full Bridge	±650 mA	30 V	3966 and 3968
PWM Current-Controlled Dual Full Bridge	±750 mA	45 V	6219
OTHER INTEGRATED CIRCUIT & PMCM MOTOR DRIVERS			
Unipolar Stepper-Motor Quad Driver	1.8 A	50 V	2544
Unipolar Stepper-Motor Translator/Driver	1.25 A	50 V	5804
Unipolar Stepper-Motor Quad Drivers	1 A	46 V	7024 and 7029
Unipolar Microstepper-Motor Quad Driver	1.2 A	46 V	7042
Voice-Coil Motor Driver	±500 mA	6 V	8932–A
Voice-Coil Motor Driver	±800 mA	16 V	8958
Voice-Coil (and Spindle) Motor Driver	±350 mA	7 V	8984

* Current is maximum specified test condition, voltage is maximum rating. See specification for sustaining voltage limits
or over-current protection voltage limits. Negative current is defined as coming out of (sourcing) the output.

† Complete part number includes additional characters to indicate operating temperature range and package style.