- **Formerly TLP298**
- **2-A Output Current Capability Per Full-H Driver**
- **Applications Include Half-H and Full-H Solenoid Drivers and Motor Drivers**
- **Wide Range of Output Supply Voltage 5 V to 46 V**
- **Separate Input-Logic Supply Voltage Thermal Shutdown**
- **Internal Electrostatic Discharge Protection**
- **High Noise Immunity**
- **3-State Outputs**
- **Minimized Power Dissipation**
- **Sink/Source Interlock Circuitry Prevents Simultaneous Conduction**
- **Improved Functional Replacement for the SGS L298**

KV PACKAGE
(TOP VIEW)

Pin	Name
15	2E
14	2Y2
13	2Y1
12	2A2
11	2EN
10	2A1
9	V_{CC1}
8	GND
7	1A2
6	1EN
5	1A1
4	V_{CC2}
3	1Y2
2	1Y1
1	1E

The tab is electrically connected to GND.
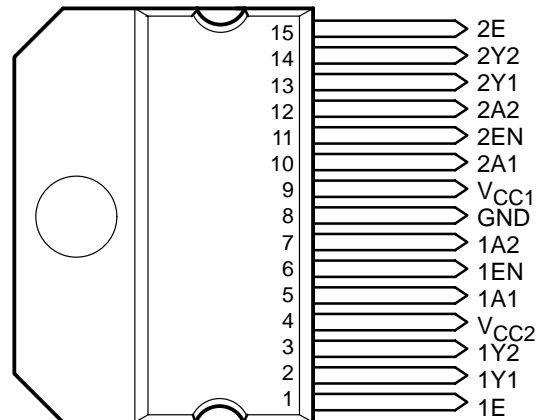
description

The TPIC0298 is a dual high-current full-H driver designed to provide bidirectional drive currents of up to 2 A at voltages from 5 V to 46 V. It is designed to drive inductive loads such as relays, solenoids, dc motors, stepping motors, and other high-current or high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output (Y) is a complete totem-pole drive with a Darlington transistor sink and a pseudo-Darlington source. Each full-H driver is enabled separately. Outputs 1Y1 and 1Y2 are enabled by 1EN and outputs 2Y1 and 2Y2 are enabled by 2EN. When an EN input is high, the associated channels are active. When an EN input is low, the associated channels are off (i.e., in the high-impedance state).

Each half of the device forms a full-H reversible driver suitable for solenoid or motor applications. The current in each full-H driver can be monitored by connecting a resistor between the sense output terminal 1E and GND and another resistor between sense output terminal 2E and GND.

logic symbol†

† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

FUNCTION TABLE

INPUTS		OUTPUT
A	**EN**	**Y**
H	H	H
L	H	L
X	L	Z

H = high-level , L = low-level
X = irrelevant
Z = high-impedance (off)

External high-speed output-clamp diodes should be used for inductive transient suppression. To minimize device power dissipation, a V_{CC1} supply voltage, separate from V_{CC2}, is provided for the logic inputs.
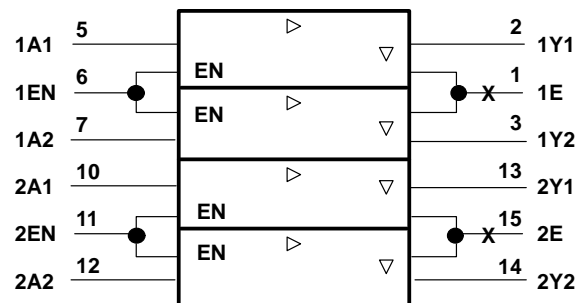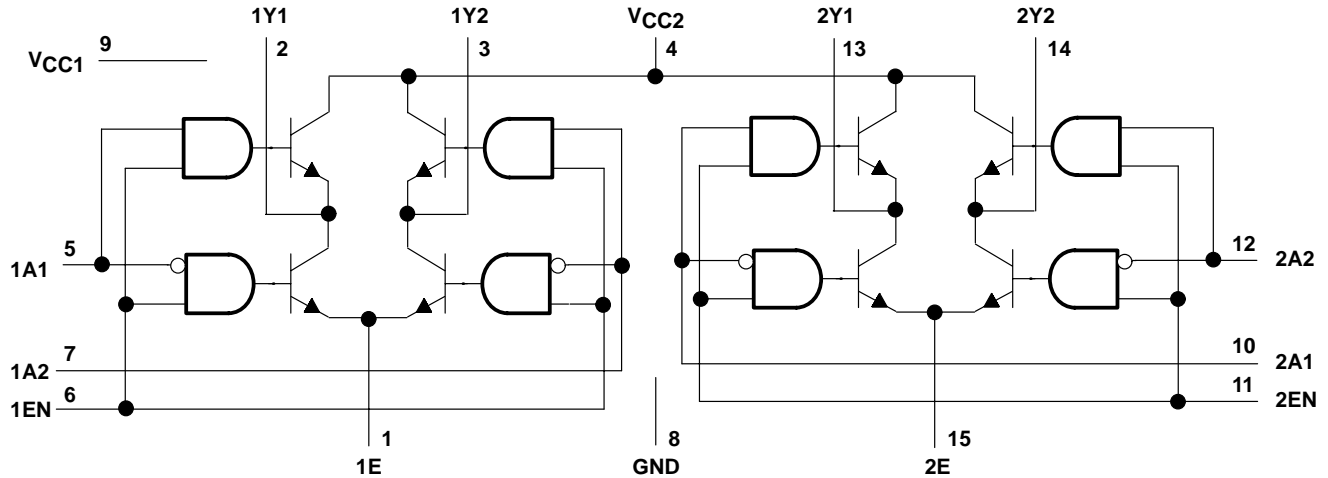
The TPIC0298 is designed for operation from 0°C to 70°C.

TEXAS INSTRUMENTS

TPIC0298
DUAL FULL-H DRIVER

logic diagram (positive logic)

absolute maximum ratings over operating temperature range (unless otherwise noted)

Logic supply voltage range, V_{CC1} (see Note 1) .... −0.3 V to 7 V
Output supply voltage range, V_{CC2} .... −0.3 V to 50 V
Input voltage range at A or EN, V_I (see Note 2) .... −1.6 V to 7 V
Output voltage range, V_O .... −2 V to V_{CC2} + 2 V
Emitter terminal (1E and 2E) voltage range, V_E .... −0.5 V to 2.3 V
Emitter terminal (1E and 2E) voltage (nonrepetitive, $t_w \leq 50$ μs) .... −1 V
Input current at A or EN, I_I .... −15 mA
Peak output current, I_{OM}: (nonrepetitive, $t_w \leq 0.1$ ms) .... ±3 A
                                 (repetitive, $t_w \leq 10$ ms, duty cycle ≤ 80%) .... ±2.5 A
Continuous output current, I_O .... ±2 A
Peak combined output current for each full-H driver (see Note 3):
                                 (nonrepetitive, $t_w \leq 0.1$ ms) .... ±3 A
                                 (repetitive, $t_w \leq 10$ ms, duty cycle ≤ 80%) .... ±2.5 A
Continuous combined output current for each full-H driver (see Note 3) .... ±2 A
Continuous dissipation at (or below) 25°C free-air temperature (see Note 4) .... 3.575 W
Continuous dissipation at (or below) 75°C case temperature (see Note 4) .... 25 W
Operating free-air, case, or virtual junction temperature range .... −40°C to 150°C
Storage temperature range .... −65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .... 260°C

NOTES: 1. All voltage values are with respect to the network GND, unless otherwise noted.
2. The maximum current limitation at this terminal generally occurs at a voltage of lower magnitude than the voltage limit. Neither the maximum current nor the maximum voltage for this terminal should be exceeded.
3. Combined output current applies to each of the two full-H drivers individually. This current is the sum of the currents at outputs 1Y1 and 1Y2 for full-H driver 1 and the sum of the currents at outputs 2Y1 and 2Y2 for full-H driver 2. The full-H drivers can carry the rated combined current simultaneously.
4. For operation above 25°C free-air temperature, derate linearly at the rate of 28.6 mW/°C. For operation above 75°C case temperature, derate linearly at the rate of 333 mW/°C. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

recommended operating conditions

			MIN	MAX	UNIT
Logic supply voltage, V_{CC1}			4.5	7	V
Output supply voltage, V_{CC2}			5	46	V
Emitter terminal (1E or 2E) voltage, V_E (see Note 5)			-0.5[†]	2	V
				$V_{CC1}-3.5$	
				$V_{CC2}-4$	
High-level input voltage, V_{IH} (see Note 5)	A		2.3	V_{CC1}	V
				$V_{CC2}-2.5$	
	EN		2.3	7	
				V_{CC1}	
Low-level input voltage at A or EN, V_{IL}			-0.3[†]	1.5	V
Output current, I_O				±2	A
Communication frequency				40	kHz
Operating free-air temperature, T_A			0	70	°C

[†] The algebraic convention, in which the least positive (most negative) limit is designated as minimum, is used in this data sheet for emitter terminal voltage and logic voltage levels.

NOTE 5: For optimum device performance, the maximum recommended voltage at any A input is 2.5 V lower than V_{CC2}, the maximum recommended voltage at any EN input is V_{CC1}, and the maximum recommended voltage at any emitter terminal is 3.5 V lower than V_{CC1} and 4 V lower than V_{CC2}.

electrical characteristics over recommended ranges of V_{CC1}, V_{CC2}, and V_E, $T_J = 25°C$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP[†]	MAX	UNIT
V_{IK}	Input clamp voltage	$I_I = -12$ mA				-0.9	-1.5	V
V_{OH}	High-level output voltage	$I_{OH} = -1$ A			$V_{CC2}-1.8$	$V_{CC2}-1.2$		V
		$I_{OH} = -2$ A			$V_{CC2}-2.8$	$V_{CC2}-1.8$		
V_{OL}	Low-level output voltage	$I_{OL} = 1$ A				$V_E+1.2$	$V_E+1.8$	V
		$I_{OL} = 2$ A				$V_E+1.7$	$V_E+2.6$	
V_{drop}	Total source pulse sink output voltage drop	$I_{OH} = -1$ A, $I_{OL} = 1$ A	See Note 6			2.4	3.4	V
		$I_{OH} = -2$ A, $I_{OL} = 2$ A				3.5	5.2	
I_{OZH}	Off-state (high-impedance state) output current, high-level voltage applied	$V_O = V_{CC2}$					500	µA
I_{OZL}	Off-state (high-impedance state) output current, low-level voltage applied	$V_O = 0$ V, $V_E = 0$ V					-500	µA
I_{IH}	High-level input current	A	$V_I = V_{IH}$	EN = H		20	100	µA
				EN = L			10	
		EN	$V_I = V_{IH} \leq V_{CC1} - 0.6$ V			6	100	
I_{IL}	Low-level input current	$V_I = 0$ V to 1.5 V					-10	µA
I_{CC1}	Logic supply current	$I_O = 0$	All outputs at high level			7	12	mA
			All outputs at low level			20	32	
			All outputs at high impedance			4	6	
I_{CC2}	Output supply current	$I_O = 0$	All outputs at high level			25	50	mA
			All outputs at low level			6	20	
			All outputs at high impedance				2	

[†] All typical values are at $V_{CC1} = 5$ V, $V_{CC2} = 42$ V, $V_E = 0$ V, $T_J = 25°C$ (unless otherwise noted).

NOTE 6: The V_{drop} specification applies for I_{OH} and I_{OL} applied simultaneously to different output channels:

$$V_{drop} = V_{CC2} - V_{OH} + V_{OL} - V_E$$

TPIC0298
DUAL FULL-H DRIVER

switching characteristics, V_{CC1} = 5 V, V_{CC2} = 42 V, V_E = 0, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{d(on)}$	Turn-on delay time, source current from A input	C_L = 30 pF, See Figure 1		0.6		µs
$t_{d(off)}$	Turn-off delay time, source current from A input			0.8		µs
t_r	Rise time, source current (turning on)			0.8		µs
t_f	Fall time, source current (turning off)			0.2		µs
$t_{d(on)}$	Turn-on delay time, source current from EN input			0.5		µs
$t_{d(off)}$	Turn-off delay time, source current from EN input			2.5		µs
$t_{d(on)}$	Turn-on delay time, sink current from A input	C_L = 30 pF, See Figure 2		1.3		µs
$t_{d(off)}$	Turn-off delay time sink current from A input			0.5		µs
t_r	Rise time, sink current (turning on)			0.2		µs
t_f	Fall time, sink current (turning off)			0.2		µs
$t_{d(on)}$	Turn-on delay time, sink current from EN input			0.3		µs
$t_{d(off)}$	Turn-off delay time, sink current from EN input			1		µs

TEXAS
INSTRUMENTS

PARAMETER MEASUREMENT INFORMATION
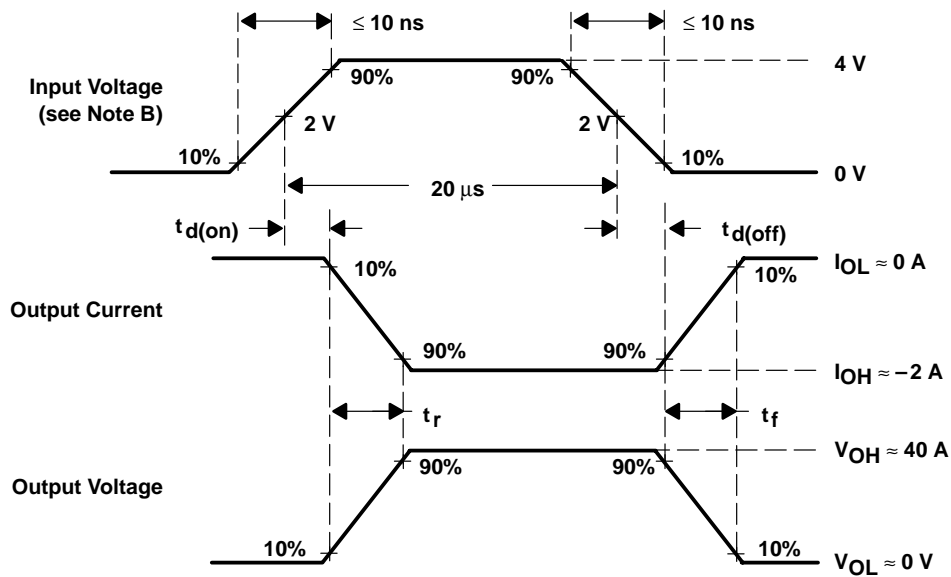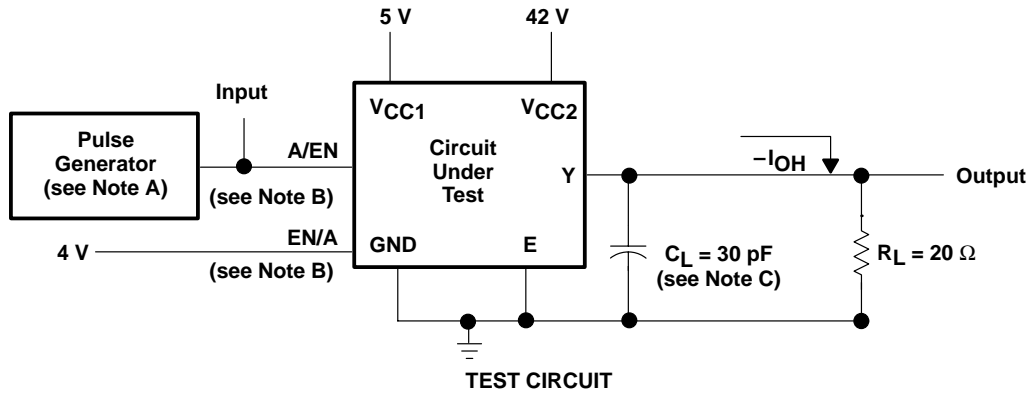
TEST CIRCUIT

VOLTAGE AND CURRENT WAVEFORMS

NOTES: A. The pulse generator has the following characteristics: PRR = 2 kHz, Z_O = 50 Ω.
   B. EN is at 4 V if A is used as the switching input. A is at 4 V if EN is the switching input.
   C. C_L includes probe and jig capacitance.

**Figure 1. Source Current Test Circuit and Waveforms From Data and Enable Inputs**
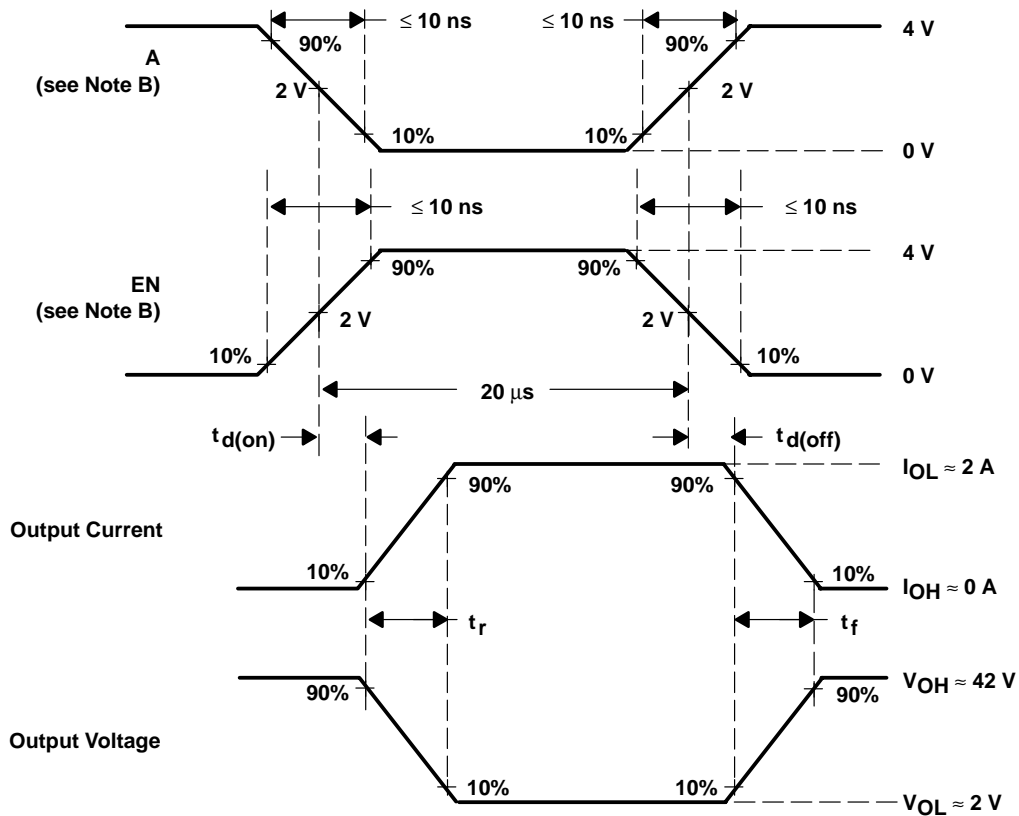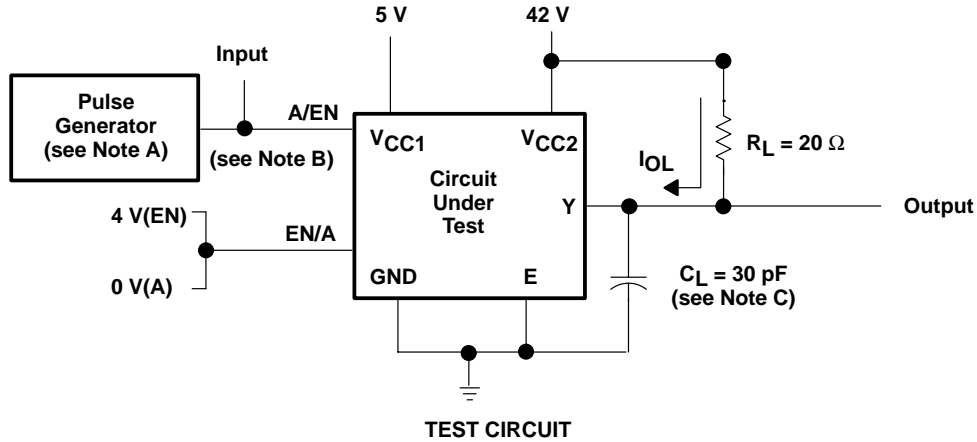
TPIC0298
DUAL FULL-H DRIVER

PARAMETER MEASUREMENT INFORMATION

TEST CIRCUIT

VOLTAGE AND CURRENT WAVEFORMS

NOTES: A. The pulse generator has the following characteristics: PRR = 2 kHz, Z_O = 50 Ω.
      B. EN is at 4 V if A is used as the switching input. A is at 0 V if EN is the switching input.
      C. C_L includes probe and jig capacitance.

Figure 2. Sink Current Test Circuit and Voltage Waveforms From Data and Enable Inputs

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INSTRUMENTS

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APPLICATION INFORMATION

This circuit shows one half of a TPIC0298 used to provide full-H bridge drive for a 24-V, 2-A dc motor. Speed control is achieved with a TLC555 timer. This provides variable duty-cycle pulses to the EN input of the TPIC0298. In this configuration, the operating frequency is approximately 1.2 kHz. The duty cycle is adjustable from 10% to 90% to provide a wide range of motor speeds. The motor direction is determined by the logic level at the direction control input. The circuit can be enabled or disabled by the logic level at the EN input. A 5-V supply for the logic and timer circuit is provided by a TL431 shunt regulator. For circuit operation, refer to the function table.

FUNCTION TABLE

ENABLE	DIRECTION CONTROL	1Y1	1Y2
H	H	Source	Sink
H	L	Sink	Source
L	X	Disabled	Disabled

X = don't care   H = high level   L = low level
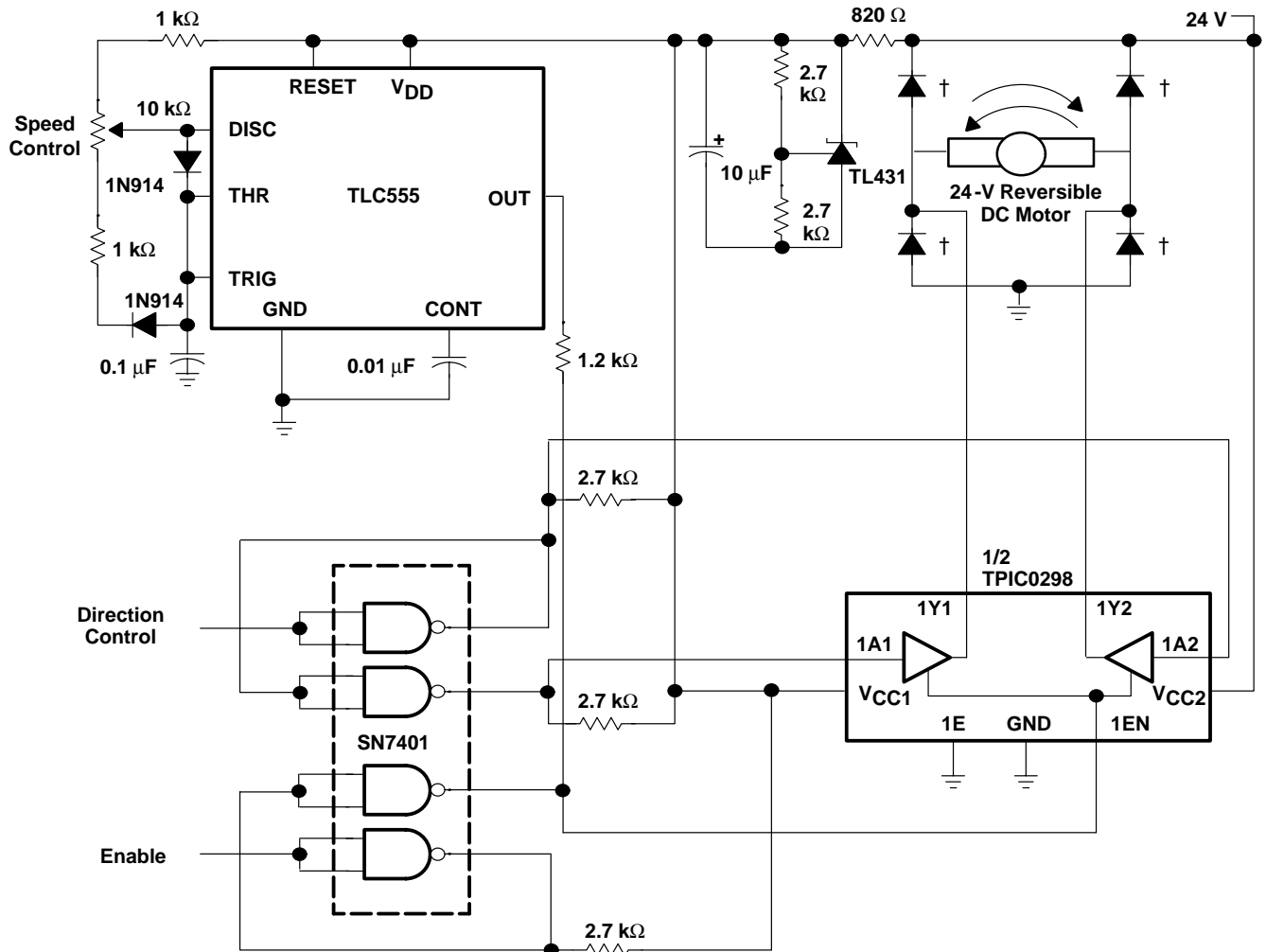
† Diodes are 1N4934 or equivalent.

Figure 3. TPIC0298 as Bidirectional-DC Motor Drive