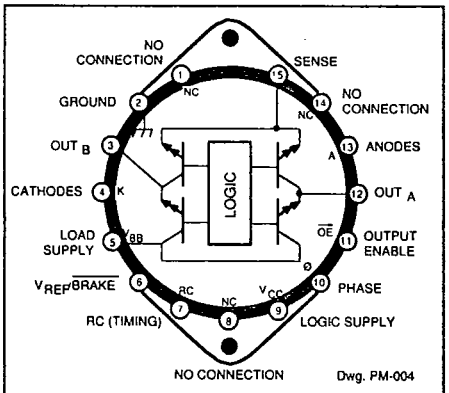
T-52-13-25

2953
MIL-STD-883 COMPLIANT

FULL-BRIDGE PWM MOTOR DRIVER



ABSOLUTE MAXIMUM RATINGS

Motor Supply Voltage, V_{BB} . . . . . **50 V**
Output Current, I_{OUT} (300 ms) . . . . . **±2.3 A**
(Continuous) . . . . . **±2.0 A**
Flyback Diode Voltage, V_K . . . . . **V_{BB}**
Minimum Clamp Diode Voltage, V_A . . . . . **Ground**
Logic Supply Voltage, V_{CC} . . . . . **7.0 V**
Logic Input Voltage Range, V_{IN} . . . . . **-0.3 V to +7.0 V***
Sense Voltage, V_{SENSE} . . . . . **1.5 V**
Reference Voltage, V_{REF}/BRAKE . . . . . **15 V**
Package Power Dissipation, P_D . . . . . **See Graph**
Operating Temperature Range, T_A . . . . . **-55°C to +125°C**
Junction Temperature, T_J . . . . . **+150°C†**
Storage Temperature Range, T_S . . . . . **-65°C to +150°C**

*V_{IN} must not exceed V_{CC}.

†Fault conditions which produce excessive junction temperature will activate device thermal shutdown circuitry. These conditions can be tolerated, but should be avoided.

Output current rating may be restricted to a value determined by system concerns and factors. These include: system duty cycle and timing, ambient temperature, and use of any heatsinking and/or forced cooling. For reliable operation the specified maximum junction temperature should not be exceeded.

Designed for bidirectional control of dc or stepper motors, the UDS2953V is rated for continuous output currents to ±2 A. For pulse-width modulated (chopped mode) operation, the output current is determined by the user's selection of a reference voltage and sensing resistor while the OFF pulse duration is set by an external RC timing network. Extensive internal circuit protection includes thermal shutdown with hysteresis, output suppression diodes to protect the bridges from the transients generated when switching inductive loads, and crossover current protection. Reverse-bias burn-in and 100% high-reliability screening to MIL-STD-883, Class B are standard.

When the V_{REF}/BRAKE pin is low (<0.8 V), the braking function is enabled. This turns both sink drivers OFF and the source drivers are turned ON. When V_{REF}/BRAKE is set above 2.4 V, that voltage (and the current sensing resistor) determines the load current trip point. An RC TIMING pin is provided for control of an internal one-shot and load current decay time.

The UDS2953V is supplied in a 15-pin, flange-mount MO-097AA style hermetic package for improved power dissipation capabilities. An external heatsink is required for high-current applications. The flange is at ground potential and normally needs no isolation.

FEATURES

- ±2 A Output Current
- Output Voltage to 50 V
- Internal Flyback Diodes
- Output Current Sensing
- Internal Thermal Shutdown Circuitry
- Crossover-Current Protected
- Hermetically Sealed Package
- High-Reliability Screening

Always order by complete part number: **UDS2953V883**.

2953
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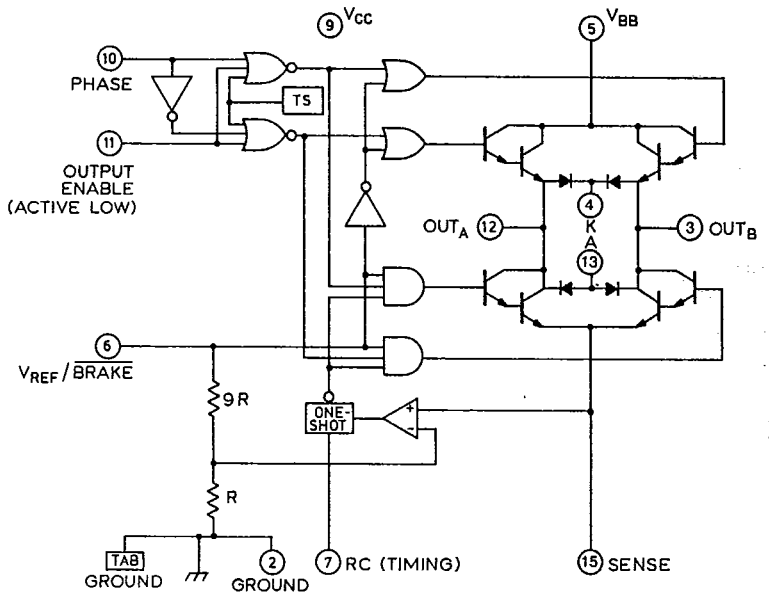
T-52-13-25

FUNCTIONAL BLOCK DIAGRAM

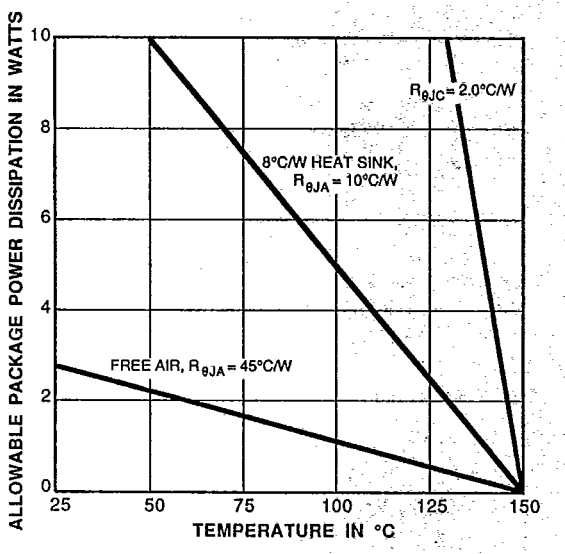


Dwg. FM-002-1

TRUTH TABLE

OUTPUT ENABLE	PHASE	$V_{REF}/\overline{BRAKE}$	OUT_A	OUT_B
Low	High	>2.4 V	High	Low
Low	Low	>2.4 V	Low	High
High	X	>2.4 V	Open	Open
X	X	<0.8 V	High	High

x = Irrelevant



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2953
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T-52-13-25

ELECTRICAL CHARACTERISTICS at T_A = -55°C to +125°C, V_{BB} = 50 V, V_{CC} = 5 V, V_{SENSE} = 0 V, 5 kΩ RC to Ground (unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			Units
			Min.	Typ.	Max.	
Output Drivers						
Supply Voltage Range	V_{BB}	Operating	6.5	—	50	V
Output Leakage Current	I_{CEX}	$V_{OUT} = V_{BB}$, V_{ENABLE} = 5.0 V, Note 3	—	<1.0	10	µA
		V_{OUT} = 0 V, V_{ENABLE} = 5.0 V, Note 3	—	<-1.0	-10	µA
Output Saturation Voltage (T_A = -55°C to +25°C)	$V_{CE(SAT)}$	I_{OUT} = ±0.5 A	—	—	1.2	V
		I_{OUT} = ±1.0 A	—	—	1.4	V
		I_{OUT} = ±2.0 A	—	—	1.8	V
Output Saturation Voltage (T_A = +125°C)	$V_{CE(SAT)}$	I_{OUT} = ±0.5 A	—	—	1.0	V
		I_{OUT} = ±1.0 A	—	—	1.2	V
		I_{OUT} = ±2.0 A	—	—	1.6	V
Output Sustaining Voltage	$V_{CE(sus)}$	I_{OUT} = ±2.0 A, L = 3 mH, T_A = +25°C, Note 3	50	—	—	V
Clamp Diode Leakage Current	I_R	V_R = 50 V	—	—	10	µA
Clamp Diode Forward Voltage	V_F	I_F = 2.0 A, T_A = -55°C to +25°C	—	—	2.1	V
		I_F = 2.0 A, T_A = +125°C	—	—	2.3	V
Motor Supply Current (No Load)	$I_{BB(ON)}$	V_{ENABLE} = 0.8 V, V_{REF} = 2.4 V	—	20	35	mA
	$I_{BB(OFF)}$	$V_{ENABLE} = V_{REF}$ = 2.4 V	—	2.4	4.0	mA
		V_{ENABLE} = 5.0 V, V_{REF} = 0.8 V	—	40	60	mA

NOTES: 1. Typical Data is for design information only and is at T_A = +25°C.

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2. Each driver is tested separately.
3. Test is performed with V_{PHASE} = 0.8 V and then repeated for V_{PHASE} = 2.4 V.
4. Negative current is defined as coming out of (sourcing) the specified device pin.

T-52-13-25

ELECTRICAL CHARACTERISTICS continued

Characteristic	Symbol	Test Conditions	Limits Min.	Typ.	Max.	Units
Control Logic						
Supply Voltage Range	V_{CC}	Operating	4.5	5.0	5.5	V
Logic Input Voltage	$V_{IN(1)}$		2.4	—	—	V
	$V_{IN(0)}$		—	—	0.8	V
Input Current	$I_{IN(1)}$	V_{IN} = 2.4 V	—	<-1.0	-20	µA
	$I_{IN(0)}$	V_{IN} = 0.8 V	—	-50	-200	µA
Current Limit Threshold		V_{REF}/V_{SENSE} at trip point, T_A = +25°C	9.5	10	10.5	—
Reference Voltage	V_{REF}	I_{REF} = 0	—	$V_{CC}/2$	—	V
Propagation Delay Time	t_{pd}	I_{OUT} = ±2.0 A, Note 3, 50% V_{PHASE} to 90% I_{OUT}	—	4.0	8.0	µs
Thermal Shutdown Temp.	T_J		—	165	—	°C
Thermal Shutdown Hysteresis	ΔT_J		—	8.0	—	°C
Logic Supply Current	I_{CC}	V_{ENABLE} = V_{REF} = 2.4 V	—	17	30	mA
		V_{ENABLE} = 0.8 V, V_{REF} = 2.4 V	—	22	35	mA

NOTES: 1. Typical Data is for design information only and is at T_A = +25°C.
2. Each driver is tested separately.
3. Test is performed with V_{PHASE} = 0.8 V and then repeated for V_{PHASE} = 2.4 V.
4. Negative current is defined as coming out of (sourcing) the specified device pin.

2953
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T-52-13-25

FIGURE 1

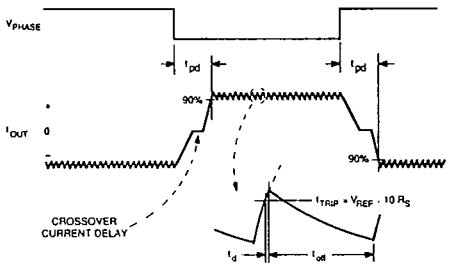

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FIGURE 2

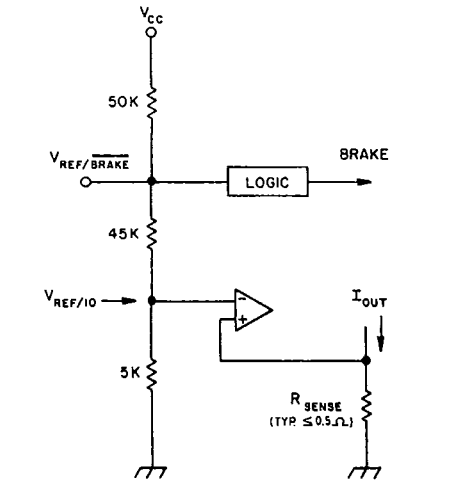

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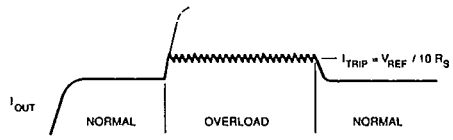
FIGURE 3



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APPLICATIONS INFORMATION

The UDS2953V full-bridge driver is ideal for driving 2-phase bipolar stepper, bidirectional dc servo, and brushless dc motors with various pulse-width modulation (PWM) current-control formats. Output current is controlled by using an external sense resistor and an optional RC network and reference voltage for an internal fixed-frequency PWM circuit, or by using an external PWM source.

The output current trip point is set up by:

$$I_{TRIP} = \frac{V_{REF}}{10\ R_{SENSE}}$$

When the current in the sense resistor (typically ≤0.5 Ω) reaches the set point, an internal one-shot turns OFF the sink drivers for a time period (t_{off}) determined by the RC time constant. The actual peak load current will be slightly higher than the trip point (especially for low-inductance loads) because of the internal logic and switching delays. This delay (t_d) is typically 2 µs.

The t_{off} time interval (see Fig. 1) is approximately 1/RC within the range of 20 kΩ to 100 kΩ and 200 pF to 500 pF. If the RC pin is tied to V_{CC}, internal delay circuitry is activated, allowing PWM operation without the external RC network. Under this condition, I_{CC} will increase approximately 6 mA. The internally generated t_{off} is approximately 12 µs at V_{CC} = 5 V and T_A = +25°C, increasing slightly with increasing temperatures. The RC pin must be connected to an RC network or to V_{CC}. It must *not* be left unconnected.

For external current control, V_{REF} can be between 2.4 V and 15 V. If left unconnected, V_{REF} defaults to $V_{CC}/2$ (see Fig. 2).

Average load current can also be adjusted by external pulse-width modulation using the OUTPUT ENABLE pin. Toggling the OUTPUT ENABLE line shuts OFF both the source and sink drivers. Both the flyback and ground-clamp diodes conduct, resulting in very fast current decay. In this mode, the RC pin should be connected to ground through a 5 kΩ resistor.

With the RC pin connected to V_{CC}, V_{REF} and R_{SENSE} selected for a trip point greater than normal operation, but less than the absolute maximum allowable, over-current protection is provided (Fig. 3).

A logic low at the V_{REF}/BRAKE pin turns ON both source drivers and turns OFF both sink drivers, thus dynamically braking the motor.

An internally generated deadtime of approximately 3 µs reduces crossover currents that can occur when switching phases or braking.

Thermal protection circuitry is activated and turns OFF all drivers at a junction temperature of typically 165°C. It is only intended to protect the chip from catastrophic failures due to excessive junction temperatures. The thermal shutdown has a hysteresis of approximately 8°C.