Ordering number : ENN6194

Monolithic Digital IC

LB1939T

2 Channel H Bridge Constant Voltage/ Constant Current Driver IC

Overview

The LB1939T is a two-phase excitation bipolar stepping motor driver that features low voltage operation, a low saturation voltage, and low power consumption. It supports constant voltage and constant current drive, can control two iris motors, and is optimal for shutter, iris, and AF drive in 3 V battery operated still digital cameras and other battery operated equipment.

Features

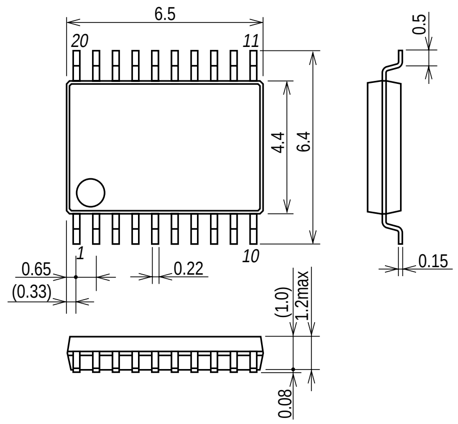
- Low-voltage drive
  - — Dual power supply operation: VS = 1.6 to 7.5 V, V_{DD} = 1.9 to 6.5 V
  - — Single power supply operation: VS = V_{DD} = 1.9 to 7.5 V
- Low saturation voltage output: Vosat = 0.3 V at I_O = 200 mA
- Supports constant voltage and constant current drive
- Built-in reference voltage circuit (Vref = 0.9 V)
- Miniature, thin form package (Thickness t = 1.1 mm)

Package Dimensions

unit: mm

3246-TSSOP20

[LB1939T]



SANYO: TSSOP20

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{Bmax}	VS1, VS2, V_{DD}	–0.3 to +10.5	V
Applied output voltage	V_{OUT}	OUT1, 2, 3, 4	–0.3 to +10.5	V
Maximum output current: OUT1, 2, 3, and 4	I_{Omax}	t ≤ 10 ms	400	mA
Applied input voltage	V_{IN}	ENA, IN, VC	10.5	V
Allowable power dissipation	Pdmax	When mounted on a printed circuit board*	0.8	W
Operating temperature	Topr		–20 to +85	°C
Storage temperature	Tstg		–55 to +150	°C

Note: Circuit board: 114.3 × 76.1 × 1.6 mm^3 glass epoxy board

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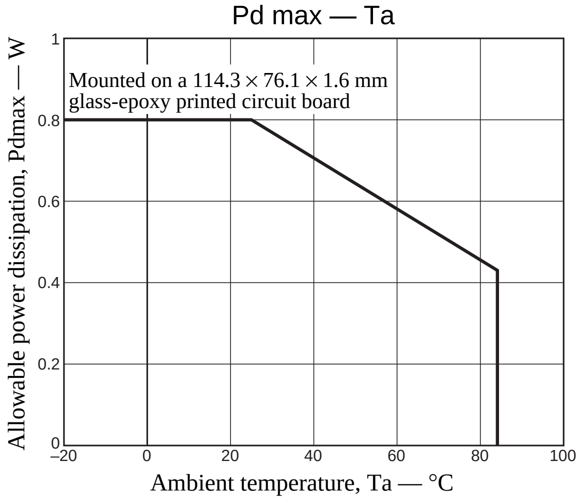
Allowable Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Operation guaranteed voltage range 1	$V_{OPR}1$	V_{DD} system, VS = 2.0 V	1.9		6.5	V
Operation guaranteed voltage range 2	$V_{OPR}2$	VS system, V_{DD} = 5.0 V	1.6		7.5	V
Input low-level threshold voltage	V_{IL}	ENA1, ENA2, IN1, IN2	–0.3		+1.0	V
Input high-level threshold voltage	V_{IH}	ENA1, ENA2, IN1, IN2	2.0		6.0	V

Electrical Characteristics at Ta = 25°C, VS = 3.0 V, V_{DD} = 5.0 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Standby mode current drain	I_{STB}	VS = V_{DD} = 6.5 V		0.1	1.0	μA
[Regulator Output Circuit]						
V_{REF} output voltage	V_{REF}	I_{OL} = 0 to 1 mA	0.85	0.9	0.95	V
SV_{DD} output voltage	VSV_{DD}	I_{OL} = 10 mA	4.7	4.8		V
[H Bridge Output Circuit]						
OUT pin output saturation voltage 1 (Saturation control mode)	Vosat1	V_{DD} = 5.0 V, VC = SV_{DD}, VS = 2.0 V I_O = 200 mA (PNP transistor side)		0.20	0.30	V
OUT pin output saturation voltage 2 (Saturation control mode)	Vosat2	V_{DD} = 5.0 V, VC = SV_{DD}, VS = 2.0 V I_O = 200 mA (NPN transistor side)		0.10	0.15	V
OUT pin output voltage 1 (Constant voltage control mode)	$V_{OUT}1$	V_{DD} = 6.0 V, VC = 1.5 V, VS = 3.5 V I_O = 200 mA (PNP transistor side)	2.8	2.9	3.0	V
OUT pin output voltage 2 (Constant voltage control mode)	$V_{OUT}2$	V_{DD} = 6.0 V, VC = V_{REF}, VS = 2.0 V I_O = 200 mA (PNP transistor side)	1.65	1.75	1.85	V
OUT pin output current 1 (Constant current control mode)	$I_{OUT}1$	V_{DD} = 6.0 V, VC = 0.9 V, VS = 3.5 V RL = 5 Ω (between OUT and OUT), RFB = 1 Ω	197	210	223	mA
OUT pin output current 2 (Constant current control mode)	$I_{OUT}2$	V_{DD} = 6.0 V, VC = V_{REF}, VS = 2.0 V RL = 5 Ω (between OUT and OUT), RFB = 1 Ω	189	210	231	mA
VS system operating current drain 1	I_S1	VC = SV_{DD}		4	7	mA
VS system operating current drain 2	I_S2	VC = VREF		1.5	3	mA
V_{DD} system operating current drain 1	$I_{DD}1$	VC = SV_{DD} ENA1 = 2 V		4	7	mA
V_{DD} system operating current drain 2	$I_{DD}2$	VC = V_{REF} ENA1 = 2 V		4	7	mA
VC input voltage range	VC		0.1		7	V
VC input current	IVC	V_{DD} = 6.0 V, VS = 2.0 V, VC = 5.0 V	0	50	100	μA
[Control Input Circuit]						
Control pin maximum input current	I_{IH}	V_{IH} = 5.5 V		70	100	μA
	I_{IL}	V_{IL} = GND	–1		0	μA

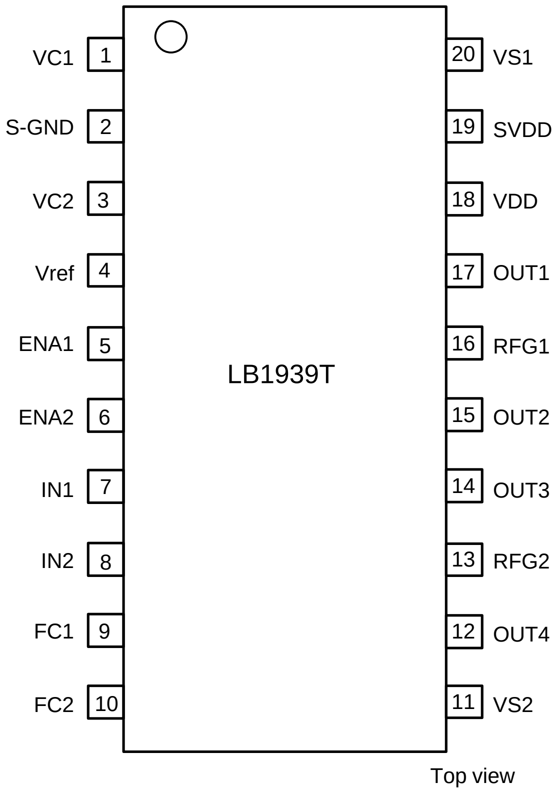
Pd max — Ta



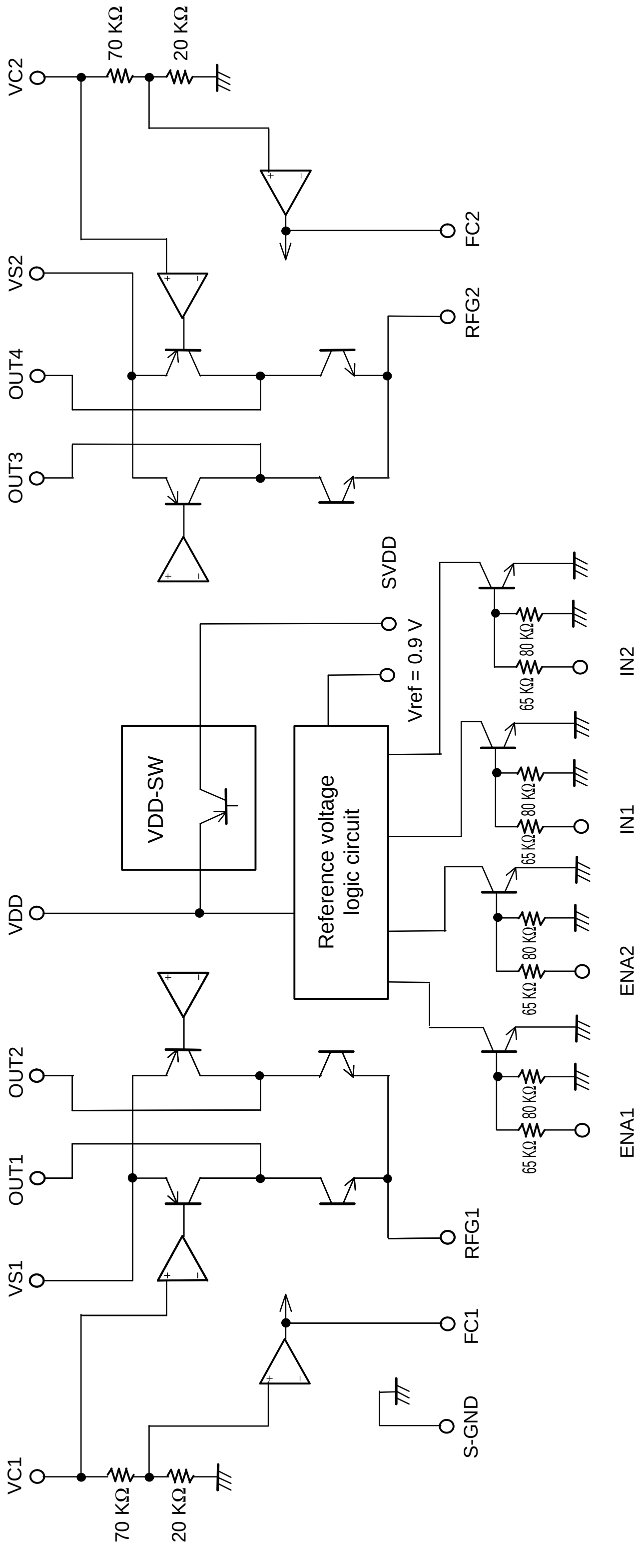
Truth Table

<table>
<tr><th colspan="4">Input</th><th colspan="5">Output</th><th rowspan="3">Mode</th></tr>
<tr><th colspan="2">ENA</th><th colspan="2">IN</th><th colspan="4">OUT</th><th rowspan="2">SVDD</th></tr>
<tr><th>1</th><th>2</th><th>1</th><th>2</th><th>1</th><th>2</th><th>3</th><th>4</th></tr>
<tr><td>L</td><td>L</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Standby mode (zero current drain)</td></tr>
<tr><td rowspan="2">H</td><td rowspan="2"></td><td>H</td><td></td><td>L</td><td>H</td><td></td><td></td><td>on</td><td>Channel 1: reverse</td></tr>
<tr><td>L</td><td></td><td>H</td><td>L</td><td></td><td></td><td>on</td><td>Channel 1: forward</td></tr>
<tr><td rowspan="2"></td><td rowspan="2">H</td><td></td><td>H</td><td></td><td></td><td>L</td><td>H</td><td>on</td><td>Channel 2: reverse</td></tr>
<tr><td></td><td>L</td><td></td><td></td><td>H</td><td>L</td><td>on</td><td>Channel 2: forward</td></tr>
<tr><td colspan="4">Blank entries indicate “don’t care” states.</td><td colspan="5">Blank entries indicate off states.</td><td></td></tr>
</table>

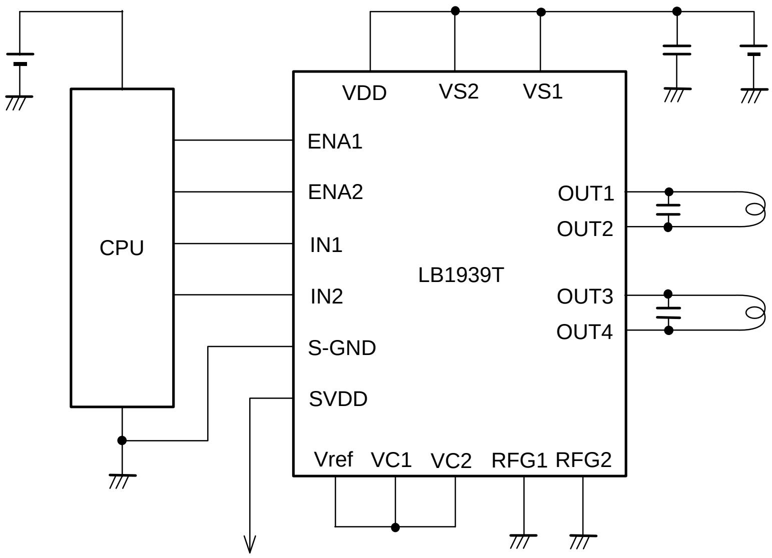
Pin Assignment



Block Diagram

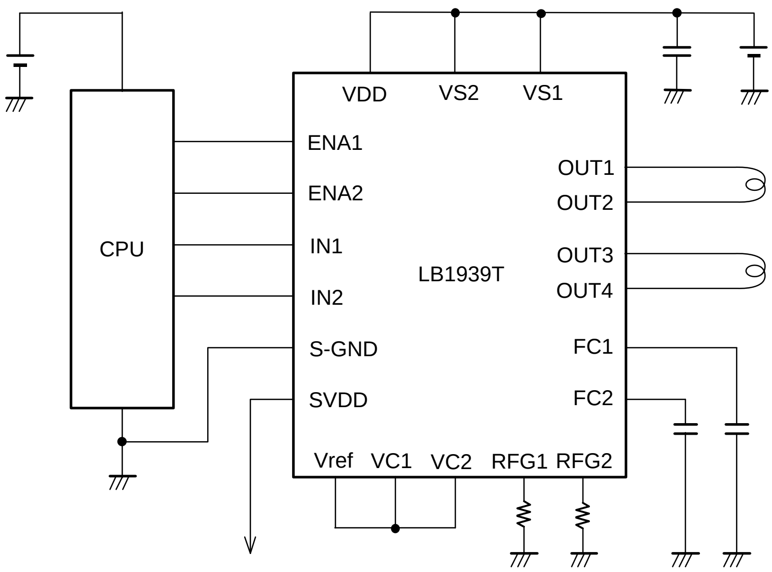


Application Circuit Example 1



Constant voltage control mode: OUT outputs a 1.75 V, which is Vref (0.9 V) × 1.95.
* : FC1 and FC2 are left open.

Application Circuit Example 2

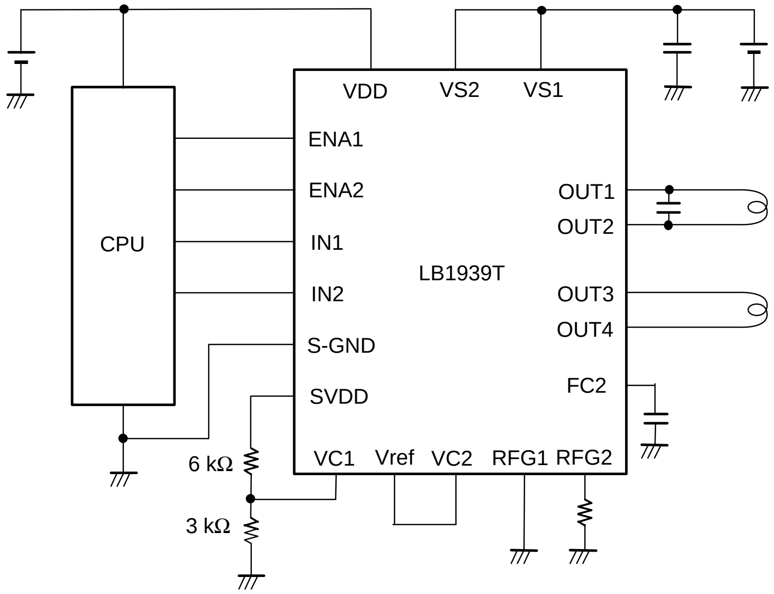


Constant current control mode: The RFG voltage is controlled so that Vref/4.5 = 0.2 V.

Therefore, when RfB is 1 Ω, the circuit operates in constant current drive with Icoil = 0.2 V/1 Ω = 200 mA.

*: There are no magnitude constraints on the inputs (ENA, IN) and the supply voltages (V_{DD}, V_S).
For example, the IC can be operated at V_{IN} = 5 V, V_{DD} = 3 V, and V_S = 2 V.

Application Circuit Example 3



Channel 1 operates in constant voltage control mode: OUT outputs $V_{DD} \times 3K/(3K + 6K) \times 1.95$
Channel 2 operates in constant current control mode: The RFG voltage is controlled so that Vref/4.5 = 0.2 V.
* : FC1 is left open.

Notes on Constant Current Control Settings

The LB1939T constant current control circuit has the structure shown in the figure at the right. The voltage input to the VC pin is resistor divided internally (by 70 kΩ and 20 kΩ resistors) to 1/4.5 and input to the plus (+) input of the constant current control amplifier as reference.

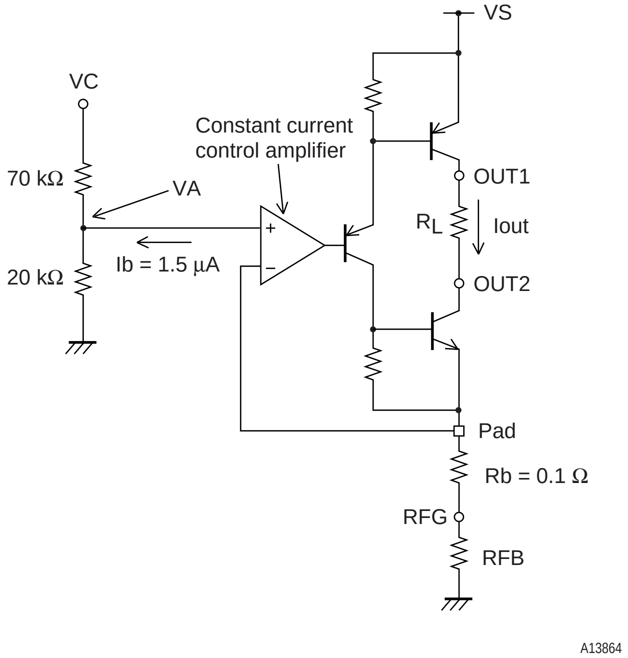
The minus (–) input of this constant current control amplifier is connected, through the wire bond resistor Rb (= 0.1 Ω), to the RFG pin. The constant current control circuit operates by comparing the voltage generated by the external current detection resistor connected to the RFG pin and the reference voltage mentioned above.

Note that the voltage at VA will be that given by the following formula since the bias current Ib (= 1.5 μA) flows from the constant current control amplifier plus (+) input during constant current control operation.

$$VA = VC/4.5 + Ib \times 20\ k\Omega$$
$$= VC/4.5 + 0.03$$

Therefore, the logical expression for setting the constant current Iout is as follows.

$$Iout = VA/(RFB + Rb)$$
$$= (VC/4.5 + 0.03) / (RFB + Rb) \text{ ......(1)}$$



Constant Current Control Usage Notes

This IC supports both constant current control and constant voltage control modes. However, since both of these control circuits operate at all times, certain of the limitations imposed by the constant voltage control circuit apply may when using constant current control.

For example, if constant current control is used with the application circuit shown in figure 2, if VC = 0.9 V (= Vref) and RFB = 1 Ω, then the output current can be calculated as follows from (1) on the previous page.

$$
\begin{aligned}
Iout &= (0.9/4.5 + 0.03) / (1 + 0.1) \\
&= 0.23/1.1 \\
&\approx 0.209A
\end{aligned}
$$

Here, if the value driven load resistance RL is r, since the RFG pin voltage is 0.23 V and the npn transistor output saturation voltage is 0.1 V (typical), the pnp transistor output pin voltage can be calculated as follows.

$$
\begin{aligned}
Vout &= (\text{RFG pin voltage}) + (\text{npn transistor output saturation voltage}) + (\text{voltage across the load terminals}) \\
&= 0.23 + 0.1 + 0.209 \times r \\
&= 0.3 + 0.209r
\end{aligned}
$$

At the same time, however, this IC’s internal constant voltage control circuit controls the output voltage as follows.

$$Vout' = VC \times 1.95 \approx 1.75\ V$$

Therefore, it will not be possible to use the constant current control mode if the value of r is set so that Vout is greater than Vout'. That is, the condition

$$0.33 + 0.209r > 1.75$$

implies that

$$r > 6.79$$

This means that constant current control can be used when the value of the load resistance used is strictly less than 6.79 Ω.