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# LB1940T

## Monolithic Digital IC 2-ch H-Bridge Constant Current Driver

### Overview

The LB1940T is 2-phase exciter type bipolar stepper motor driver ICs that feature low-voltage, (supporting 3V battery) and low current operation with low saturation voltage. This IC enable constant-current control of actuators, and are optimal for driving the actuators of PC peripherals such as USB compatible scanners, FDDs, and printers, as well as for controlling the shutter, iris, and AF of a digital still camera.

### Features

- Low-voltage driving  
2-power source type:  $V_S = 1.6$  to  $7.5V$ ,  $V_{DD} = 1.9$  to  $6.5V$   
Single power source type:  $V_S = V_{DD} = 1.9$  to  $7.5V$
- Low saturation output:  $V_{O(sat)} = 0.3V$  at  $I_O$  of  $200mA$
- Constant-current control
- Built-in reference voltage ( $V_{ref} = 0.9V$ )
- Small-sized, low-profile package (TSSOP20; 225mil; thickness (t) = 1.2mm max.)

### Specifications

#### Absolute Maximum Ratings at $T_a = 25^\circ C$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_B$ max	$V_{S1}$ , $V_{S2}$ , $V_{DD}$	-0.3 to +10.5	V
Output applied voltage	$V_{OUT}$ max	OUT1, OUT2, OUT3, OUT4	-0.3 to +10.5	V
Output Current	$I_O$ max		400	mA
Input applied voltage	$V_{IN}$ max	ENA1, ENA2, IN1, IN2, VC	-0.3 to +10.5	V
Allowable power dissipation	$P_d$ max	Mounted on a specified board *	800	mW
Operating temperature	$T_{opr}$		-20 to +85	$^\circ C$
Storage temperature	$T_{stg}$		-55 to +150	$^\circ C$

\* Mounted on a Specified board: 114.3mm×76.1mm×1.6mm, glass epoxy

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

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## Allowable Operating Range at Ta = 25°C

Parameter	Symbol	Conditions	Ratings			unit
			min	typ	max	
Function-guaranteed voltage range	VOPR1	V <sub>DD</sub> system, VS = 2.0V	1.9		6.5	V
	VOPR2	VS system, V <sub>DD</sub> = 5.0V	1.6		7.5	
Low level input threshold voltage	V <sub>IL</sub>	ENA1, ENA2, IN1, IN2	-0.3		1.0	V
High level input threshold voltage	V <sub>IH</sub>	ENA1, ENA2, IN1, IN2	2.0		6.0	V
VC input voltage	VC		0.19		1.0	V

## Electrical Characteristics at Ta = 25°C, VS = 3V, V<sub>DD</sub> = 5V

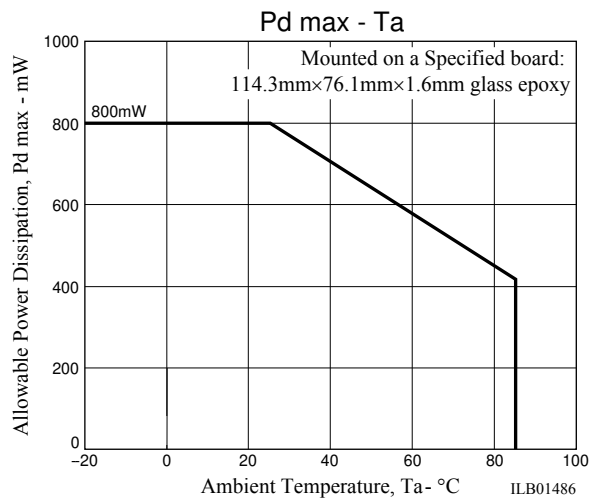
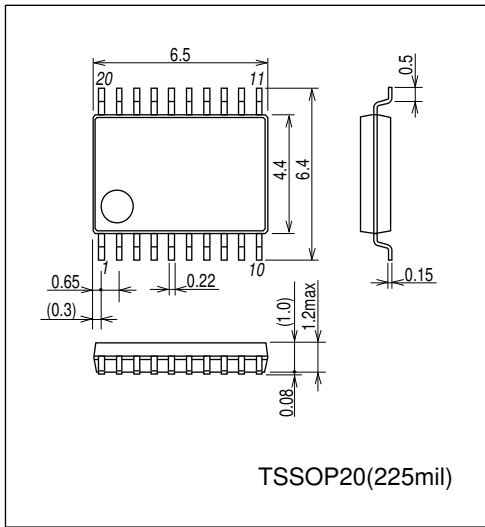
Parameter	Symbol	Conditions	Ratings			unit
			min	typ	max	
Standby current dissipation	ISTB	VS = V <sub>DD</sub> = 6.5V		0.1	1.0	μA
<b>Regulator output circuit</b>						
VREF output voltage	VREF	I <sub>OL</sub> = 0 to 1mA	0.85	0.9	0.95	V
SVDD output voltage	VSVDD	I <sub>OL</sub> = 10mA	4.70	4.85		V
<b>H bridge output circuit</b>						
OUT output saturation voltage (at saturation control)	V <sub>O(sat)1</sub>	V <sub>DD</sub> = 5.0V, VS = 2.0V I <sub>O</sub> = 200mA (PNP side)		0.20	0.30	V
	V <sub>O(sat)2</sub>	V <sub>DD</sub> = 5.0V, VS = 2.0V I <sub>O</sub> = 200mA (NPN side)		0.10	0.15	V
OUT output current (at constant current control)	I <sub>OUT1</sub>	V <sub>DD</sub> = 6.0V, VC = 0.2V, VS = 3.5V R <sub>L</sub> = 5Ω (between OUT-OUT), RFB = 2Ω	94	100	106	mA
	I <sub>OUT2</sub>	$VC = \frac{R_b}{R_a + R_b} VREF \text{ (} R_a = 70k\Omega, R_b = 20k\Omega \text{)}$ * V <sub>DD</sub> = 6.0V, VS = 2.0V R <sub>L</sub> = 5Ω (between OUT-OUT), RFB = 1Ω	180	200	220	mA
VS system operating current consumption	IS1	$VC = \frac{R_b}{R_a + R_b} VREF \text{ (} R_a = 70k\Omega, R_b = 20k\Omega \text{)}$ *		1.5	3	mA
V <sub>DD</sub> system operating current dissipation	I <sub>DD1</sub>	$VC = \frac{R_b}{R_a + R_b} VREF \text{ (} R_a = 70k\Omega, R_b = 20k\Omega \text{)}$ * ENA1 = 2V		4	7	mA
VC input current	IVC	V <sub>DD</sub> = 6.0V, VS = 2.0V, VC = 1.9V	0		-1	μA
<b>Control input circuit</b>						
Control pin maximum input current	I <sub>IH</sub>	V <sub>IH</sub> = 5.5V		80	100	μA
	I <sub>IL</sub>	V <sub>IL</sub> = GND	-1		0	

\* For Ra and Rb, refer to Application Circuit Diagram.

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## Package Dimensions

unit : mm (typ)

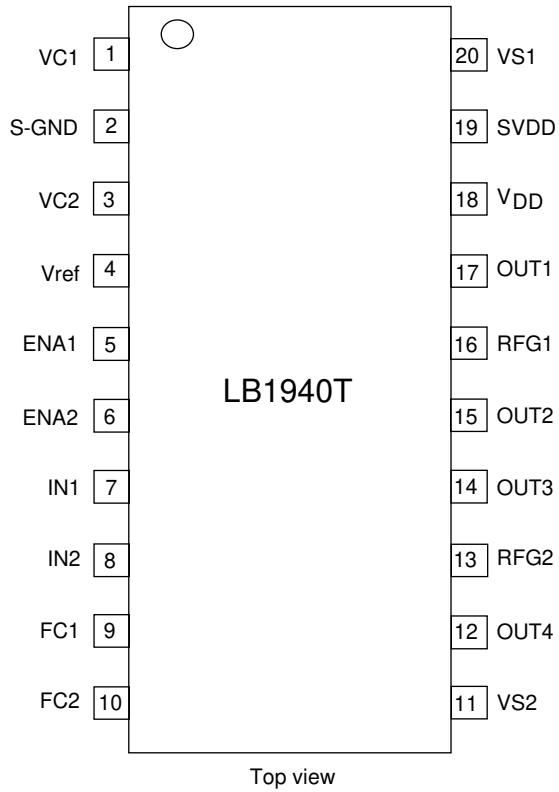


## True Table

Input				Output				SVDD	Mode
ENA		IN		OUT					
1	2	1	2	1	2	3	4		
L	L								Standby (current dissipation zero)
H		H		L	H			on	Reverse rotation
		L		H	L			on	Forward rotation
	H		H			L	H	on	Reverse rotation
			L			H	L	on	Forward rotation
A blank means "don't care".				A blank means "off".					

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## Pin Assignment

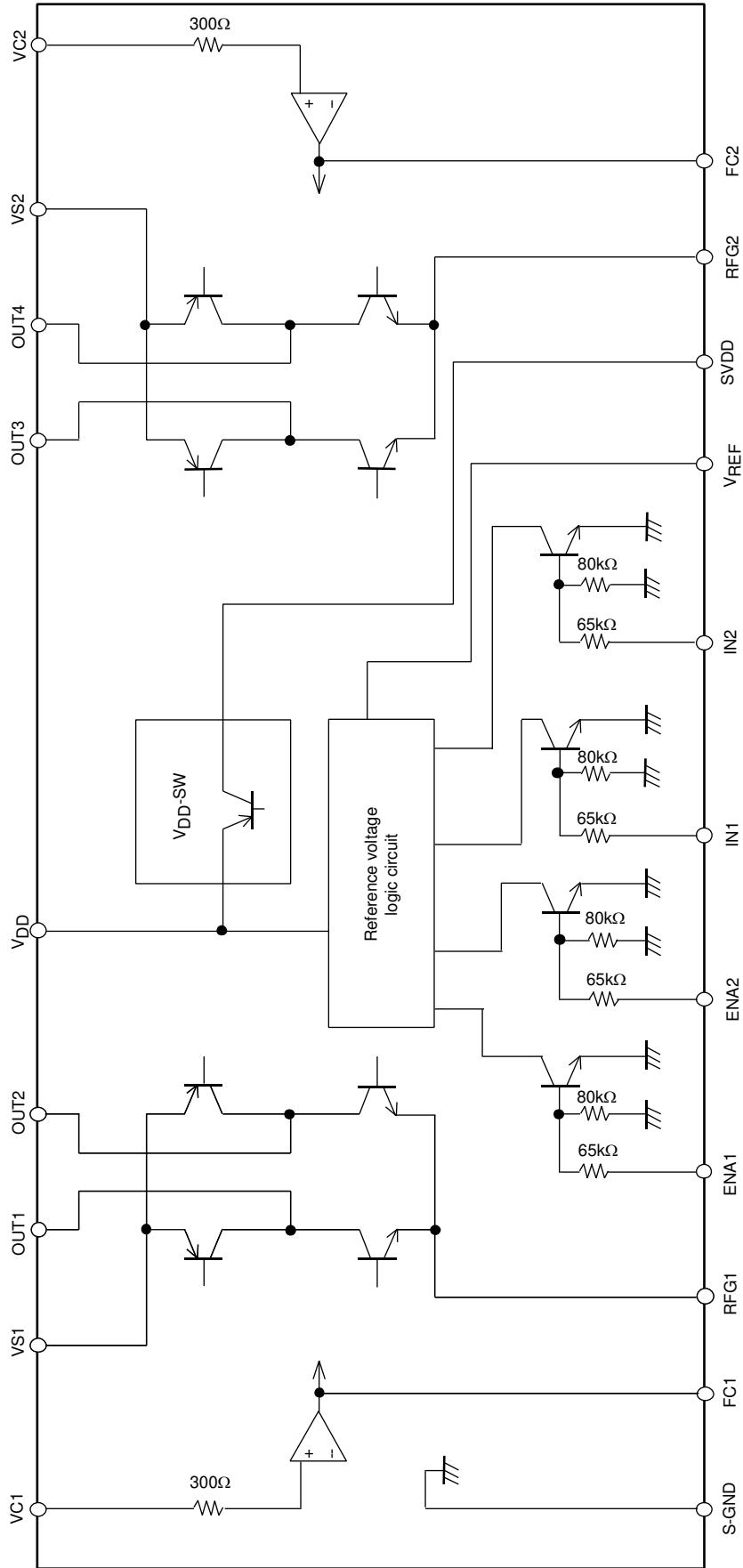


## Pin Description

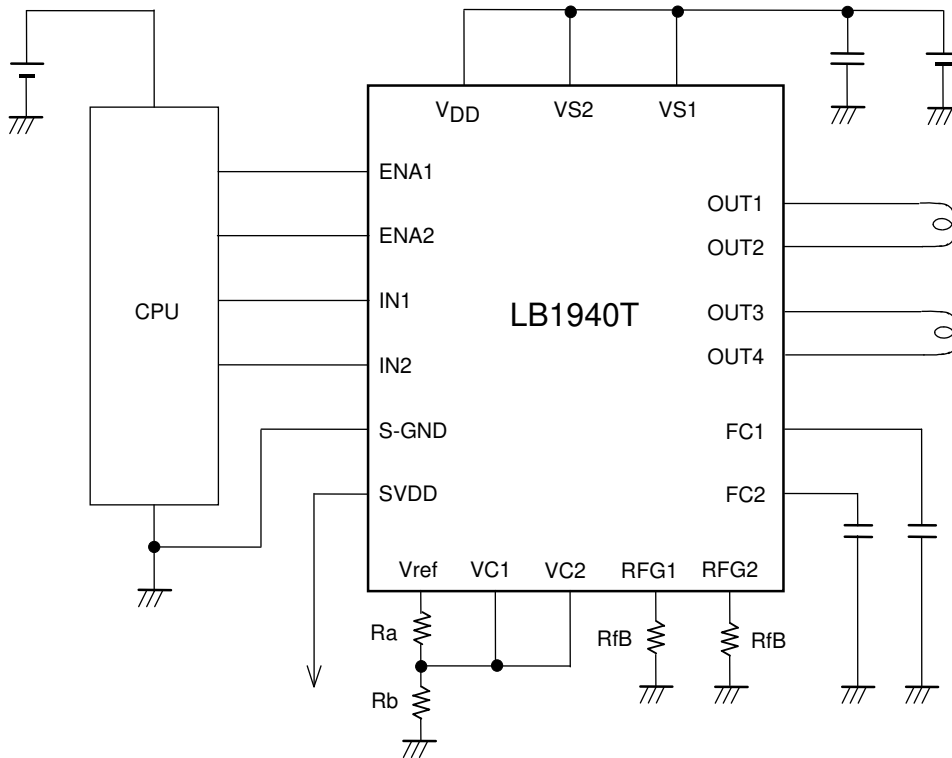
Pin No. LB1940T	Pin Name	Description	Pin No. LB1940T	Pin Name	Description
1	VC1	Reference voltage input for 1ch control	11	VS2	Motor power supply (+)
2	S-GND	GND for control system	12	OUT4	Motor drive output 4
3	VC2	Reference voltage input for 2ch control	13	RFG2	Constant-current detection pin
4	Vref	Reference voltage output	14	OUT3	Motor drive output 3
5	ENA1	Signal input for 1ch control	15	OUT2	Motor drive output 2
6	ENA2	Signal input for 2ch control	16	RFG1	Constant-current detection pin 1
7	IN1	Signal input for 1ch control	17	OUT1	Motor drive output 1
8	IN2	Signal input for 2ch control	18	V <sub>DD</sub>	Control system power supply (+)
9	FC1	C connection pin for 1ch phase compensation	19	SVDD	Control system power output
10	FC2	C connection pin for 2ch phase compensation	20	VS1	Motor power supply (+)

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## Block Diagram



Application Circuit Diagram



At constant-current control: The OUT current is controlled so that the RFG pin voltage is equal to the VC input pin voltage.

For example,  $I_{OUT} = 200\text{mA}$  ( $= 0.2\text{V}/1\Omega$ ) when  $VC = 0.2\text{V}$  and  $R_{FB} = 1\Omega$ .

\*: There is no priority relationship between respective input voltages (ENA, IN) and respective supply voltages ( $V_{DD}$ , VS). For example, operation with  $V_{IN} = 5\text{V}$ ,  $V_{DD} = 3\text{V}$ ,  $VS = 2\text{V}$  is possible.

Note: The input voltage range to the reference voltage input pin VC for constant-current setting is from 0.19V to 1.0V.

Constant current setting

The composition of the constant-control circuit of this IC is as shown in the figure below.

The voltage entered in the VC pin is entered as a reference to the “+” side input of the constant-current control amplifier.

The “-” side of this constant-current control amplifier is connected to the RFG pin via the wire bonded resistor  $R_b$  ( $= 0.1\Omega$ ).

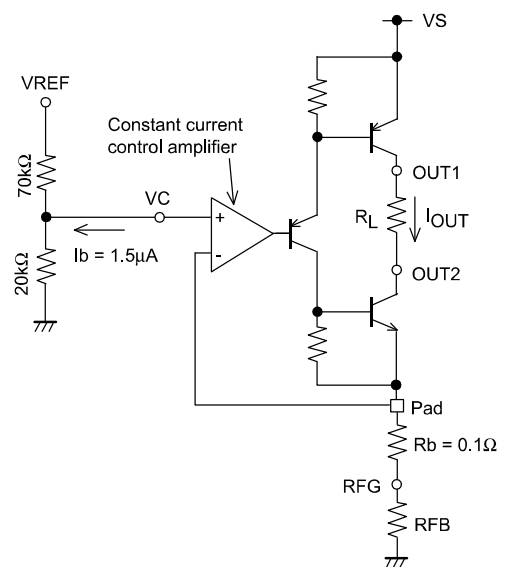
The constant-current control circuit consists of comparison of the voltage generated at the external current detection resistor with the above reference voltage.

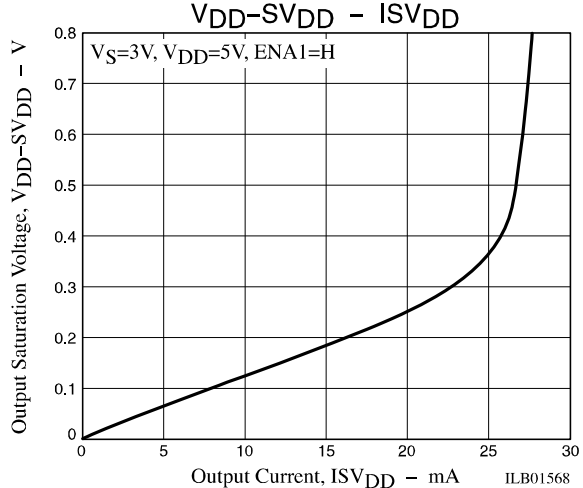
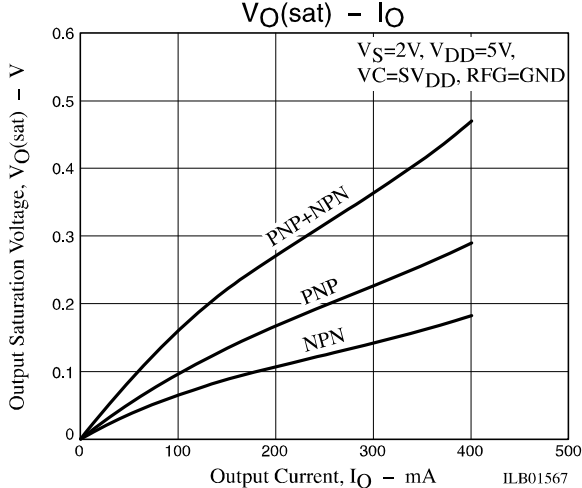
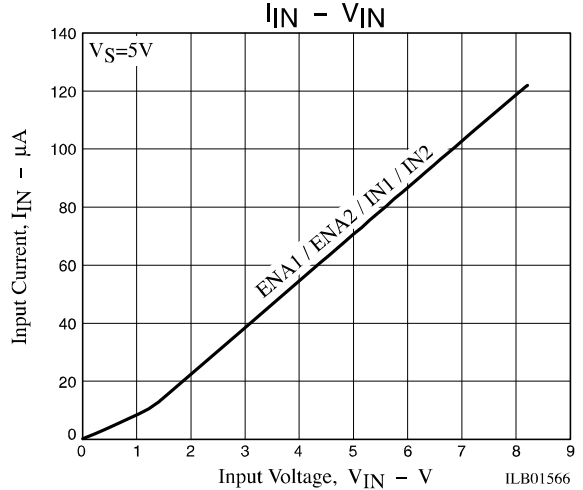
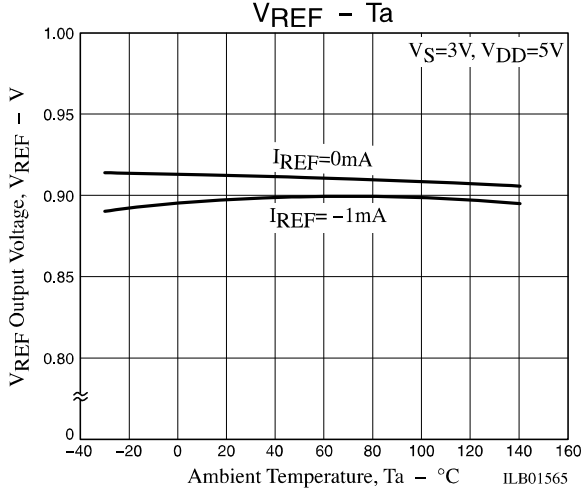
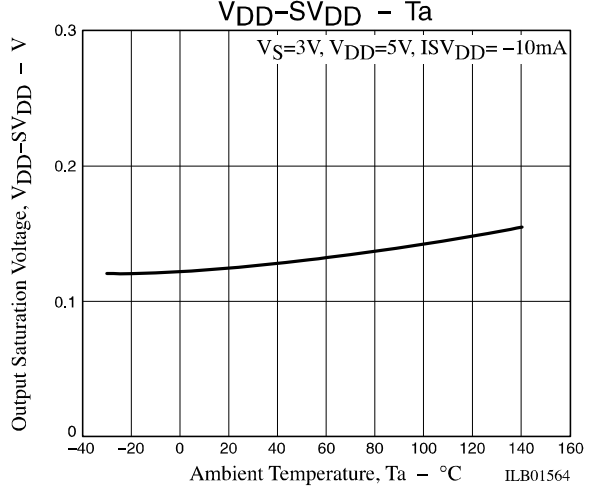
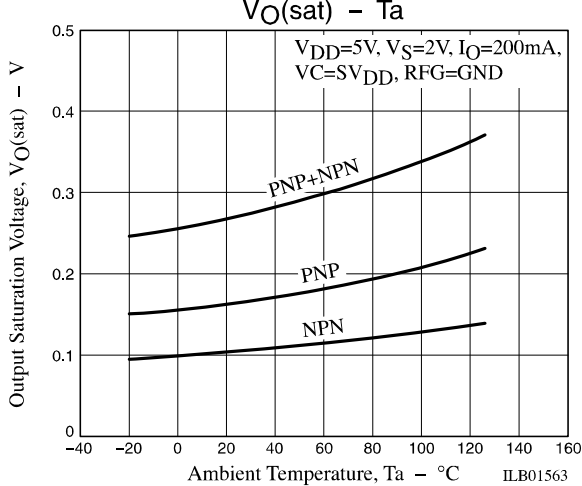
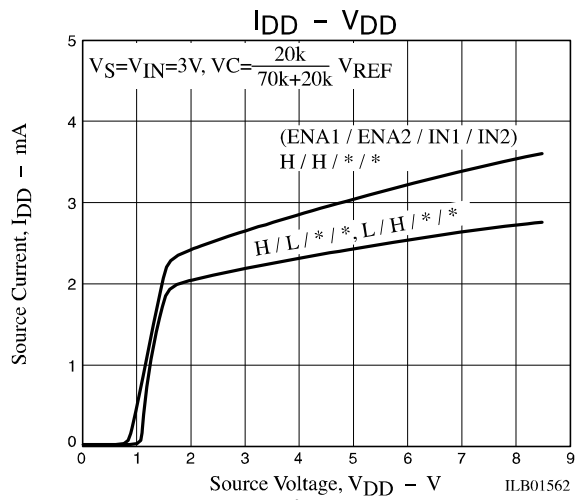
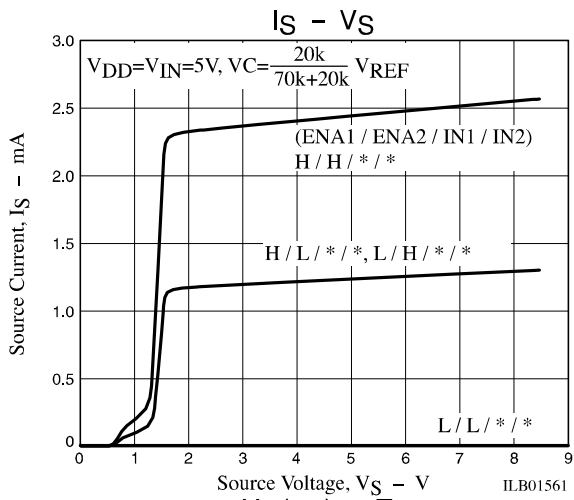
In addition, since the bias current  $I_b$  ( $= 1.5\mu\text{A}$ ) flows out of the positive (+) input of the constant current control amplifier during the constant current control, if the voltage is input to the VC pin by dividing the VREF voltage by 4.5 according to the dividing resistance ( $70\text{k}\Omega$  and  $20\text{k}\Omega$ ) as shown in the figure, the formula for calculating the VC voltage is as follows :

$$VC = V_{REF}/4.5 + I_b \times 20\text{k}\Omega = V_{REF}/4.5 + 0.03$$

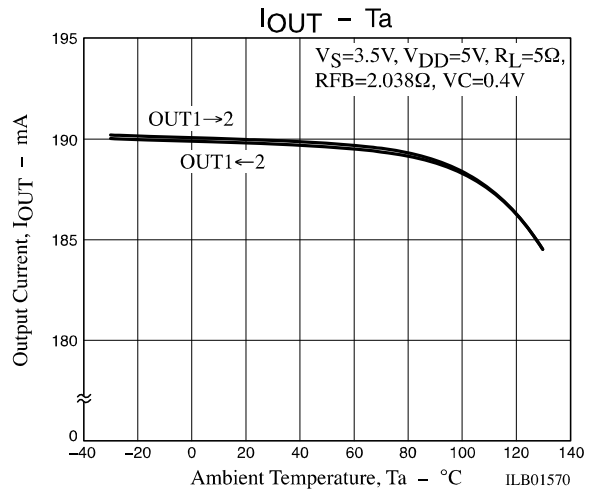
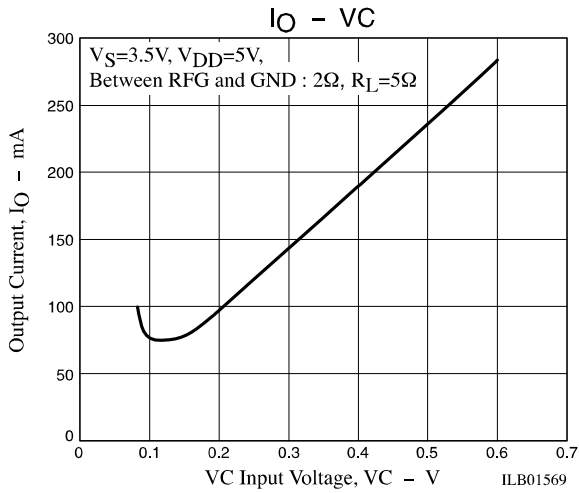
Therefore, the theoretical equation to set the constant current  $I_{OUT}$  is as follows:

$$I_{OUT} = VC / (R_{FB} + R_b) = (V_{REF}/4.5 + 0.03) / (R_{FB} + R_b)$$





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## ORDERING INFORMATION

Device	Package	Shipping (Qty / Packing)
LB1940T-MPB-E	TSSOP20(225mil) (Pb-Free)	70 / Fan-Fold
LB1940T-MPB-H	TSSOP20(225mil) (Pb-Free / Halogen Free)	70 / Fan-Fold
LB1940T-TLM-H	TSSOP20(225mil) (Pb-Free / Halogen Free)	2000 / Tape and Reel

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