Ordering number : EN6192B

SANYO Semiconductors
DATA SHEET

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LB1947 — Monolithic Digital IC PWM Current Control Type Bidirectional Motor Driver

Overview

The LB1947 is a PWM current control type bidirectional motor driver IC.

Features

- PWM current control (fixed OFF time)
- Selectable current decay pattern (FAST, SLOW, and MIX DECAY modes)
- Simultaneous ON prevention function (feed-through current prevention)
- Built-in thermal shutdown circuit
- Built-in noise canceler

Specifications

Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum motor supply voltage	V_{BB} max		50	V
Output peak current	I_O peak	$t_W \leq 20\mu s$	2.25	A
Output continuous current	I_O max		2.0	A
Logic supply voltage	V_{CC} max		7.0	V
Logic input voltage range	V_{IN}		-0.3 to V_{CC}	V
Emitter output voltage	V_E max		1.1	V
Reference voltage	V_{REF}		-0.3 to V_{CC}	V
Allowable power dissipation	Pd max		1.6	W
Operating temperature	Topr		-20 to +85	°C
Storage temperature	Tstg		-55 to +150	°C

Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage	V_{BB}		10 to 45	V
Logic supply voltage	V_{CC}		4.75 to 5.25	V
Reference voltage	V_{REF}		0 to V_{CC}-2	V

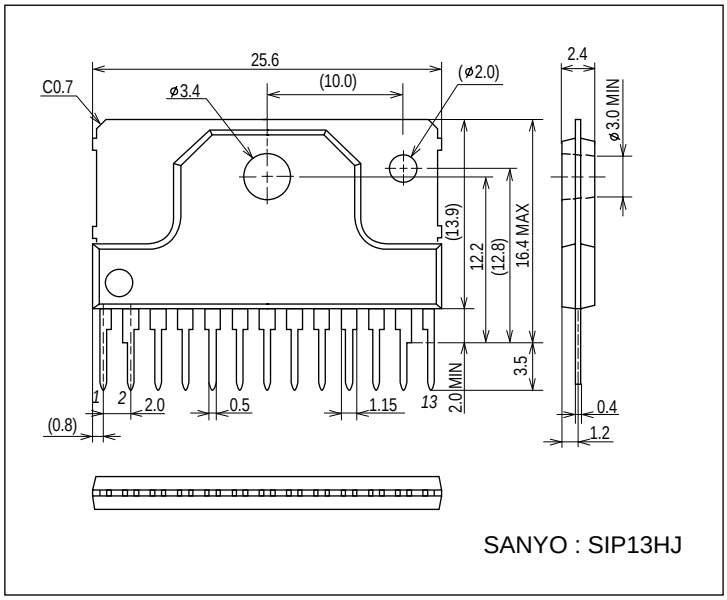
Electrical Characteristics at Ta = 25°C, V_{CC} = 5V

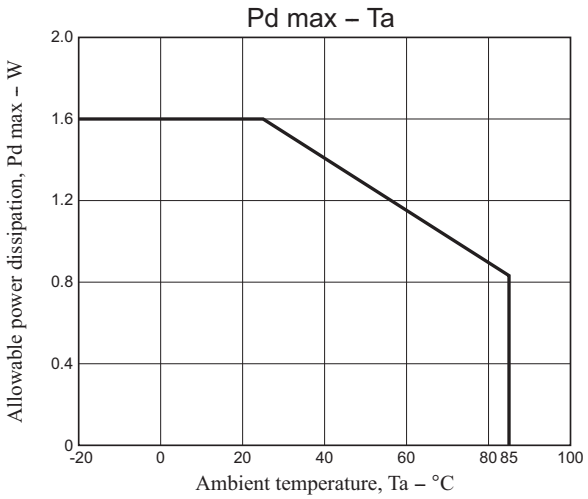
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Output Block						
Output stage supply current	I_{BB} ON	No-load state, Forward	0.4	0.6	1.0	mA
	I_{BB} BR	No-load state, Brake	0.2	0.4	0.8	mA
	I_{BB} OFF	No-load state, Output off	0.2	0.4	0.8	mA
	I_{BB} wt	No-load state, Standby mode			0.1	mA
Output saturation voltage	$V_O$sat1	I_O = +1.0A, Sink		1.2	1.5	V
	$V_O$sat2	I_O = +2.0A, Sink		1.6	1.9	V
	$V_O$sat3	I_O = -1.0A, Source		1.8	2.2	V
	$V_O$sat4	I_O = -2.0A, Source		2.1	2.4	V
Output leak current	I_O1(leak)	V_O = V_{BB}, Sink			50	μA
	I_O2(leak)	V_O = 0V, Source	-50			μA
Output sustain voltage	V_{SUS}	L = 3.9mH, I_O = 2.0A, Design guarantee value*	50			V
Logic Block						
Logic supply current	I_{CC} ON	IN1: High, IN2: Low, ST: High	11	16	21	mA
	I_{CC} BR	IN1: Low, IN2: High, ST: High	11	16	21	mA
	I_{CC} OFF	IN1: Low, IN2: Low, ST: High	11	16	21	mA
	I_{CC} wt	ST: Low	1.0	2	3.0	mA
Input voltage	V_{IN}H		2			V
	V_{IN}L				0.8	V
Input current	I_{IN}H	V_{IN} = 5V	60	90	120	μA
	I_{IN}L	V_{IN} = 0.8V	6	10	13	μA
Sensing voltage	V_E		0		1.1	V
Sensing voltage 25H	V_{EH}25	VI = High, V_{REF} = 2.5V	0.970	1.0	1.030	V
Sensing voltage 25L	V_{EL}25	VI = Low, V_{REF} = 2.5V	0.483	0.5	0.513	V
Sensing voltage 15H	V_{EH}15	VI = High, V_{REF} = 1.5V	0.385	0.4	0.410	V
Sensing voltage 15L	V_{EL}15	VI = Low, V_{REF} = 1.5V	0.190	0.2	0.210	V
Sensing voltage 05H	V_{EH}05	VI = High, V_{REF} = 0.5V	0.190	0.2	0.210	V
Sensing voltage 05L	V_{EL}05	VI = Low, V_{REF} = 0.5V	0.092	0.1	0.108	V
Reference current	Iref	V_{REF} = 1.0V	-0.5		+0.5	μA
CR pin current	I_{CR}		-1.56	-1.3	-1.04	mA
MD pin voltage	V_{MD}H		V_{CC}-0.3			V
	V_{MD}M		0.3V_{CC}		V_{CC}-1.0	V
	V_{MD}L				.0.4	V
MD input current	I_{MD}H	MD = V_{CC}-0.5V, CR = 1.0V	-1.0		+1.0	μA
	I_{MD}L	MD = 0.4V, CR = 2.0V	-5.0			μA
Thermal shutdown temperature	TSD	Design guarantee value*		170		°C

* Design guarantee value, Do not measurement.

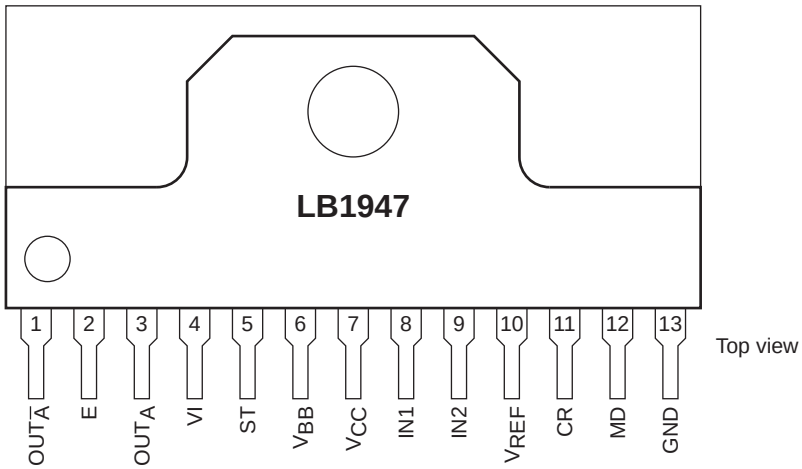
Package Dimensions

unit : mm (typ)
3249

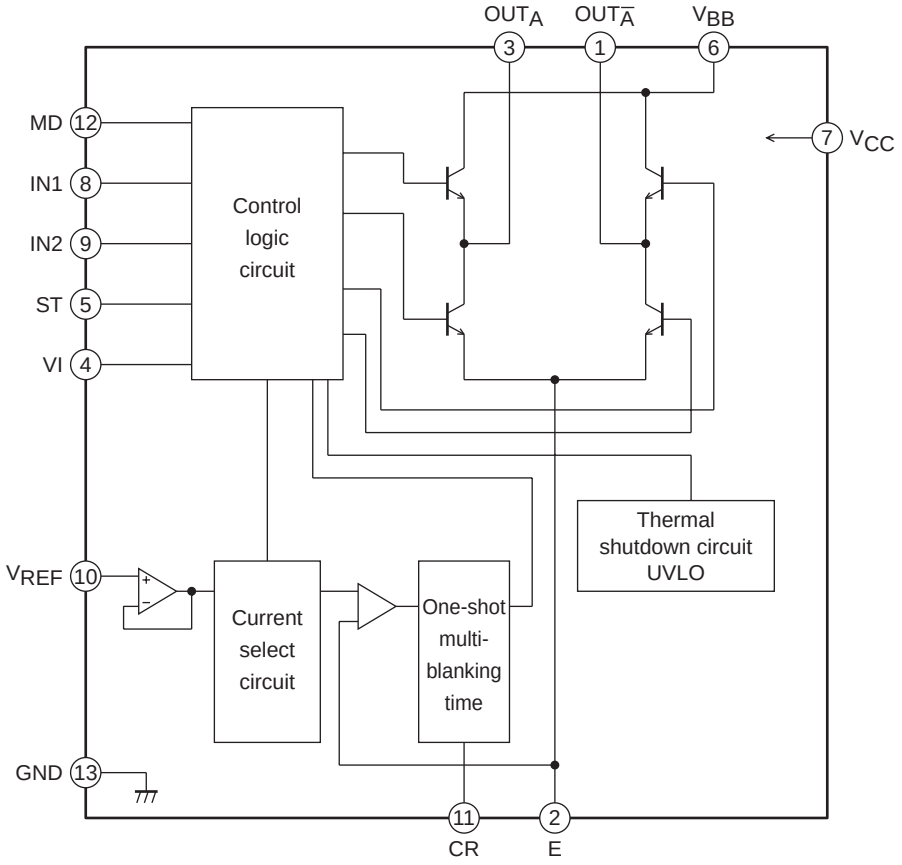




Pin Assignment



Block Diagram

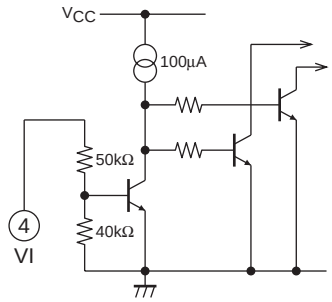
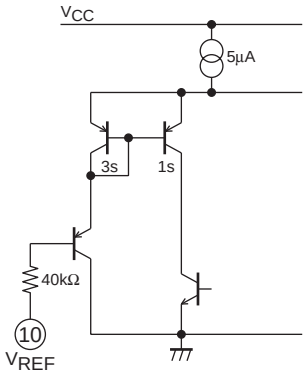


Truth Table

IN1	IN2	ST	VI	MD	OUT_A	$OUT_{\overline{A}}$	Operating mode
H	L	H	H	L	H	L	Forward, 2/5 times, FAST
H	L	H	H	M	H	L	Forward, 2/5 times, MIX
H	L	H	H	H	H	L	Forward, 2/5 times, SLOW
H	L	H	L	L	H	L	Forward, 1/5 times, FAST
H	L	H	L	M	H	L	Forward, 1/5 times, MIX
H	L	H	L	H	H	L	Forward, 1/5 times, SLOW
H	H	H	H	L	L	H	Reverse, 2/5 times, FAST
H	H	H	H	M	L	H	Reverse, 2/5 times, MIX
H	H	H	H	H	L	H	Reverse, 2/5 times, SLOW
H	H	H	L	L	L	H	Reverse, 1/5 times, FAST
H	H	H	L	M	L	H	Reverse, 1/5 times, MIX
H	H	H	L	H	L	H	Reverse, 1/5 times, SLOW
L	H	H	H	L	L	L	Brake, 2/5 times, FAST
L	H	H	H	M	L	L	Brake, 2/5 times, MIX
L	H	H	L	L	L	L	Brake, 1/5 times, FAST
L	H	H	L	M	L	L	Brake, 1/5 times, MIX
L	H	H	X	H	L	L	Brake, no current limiting
L	L	H	X	X	OFF	OFF	Output OFF
X	X	L or OPEN	X	X	OFF	OFF	Standby mode (circuit OFF)

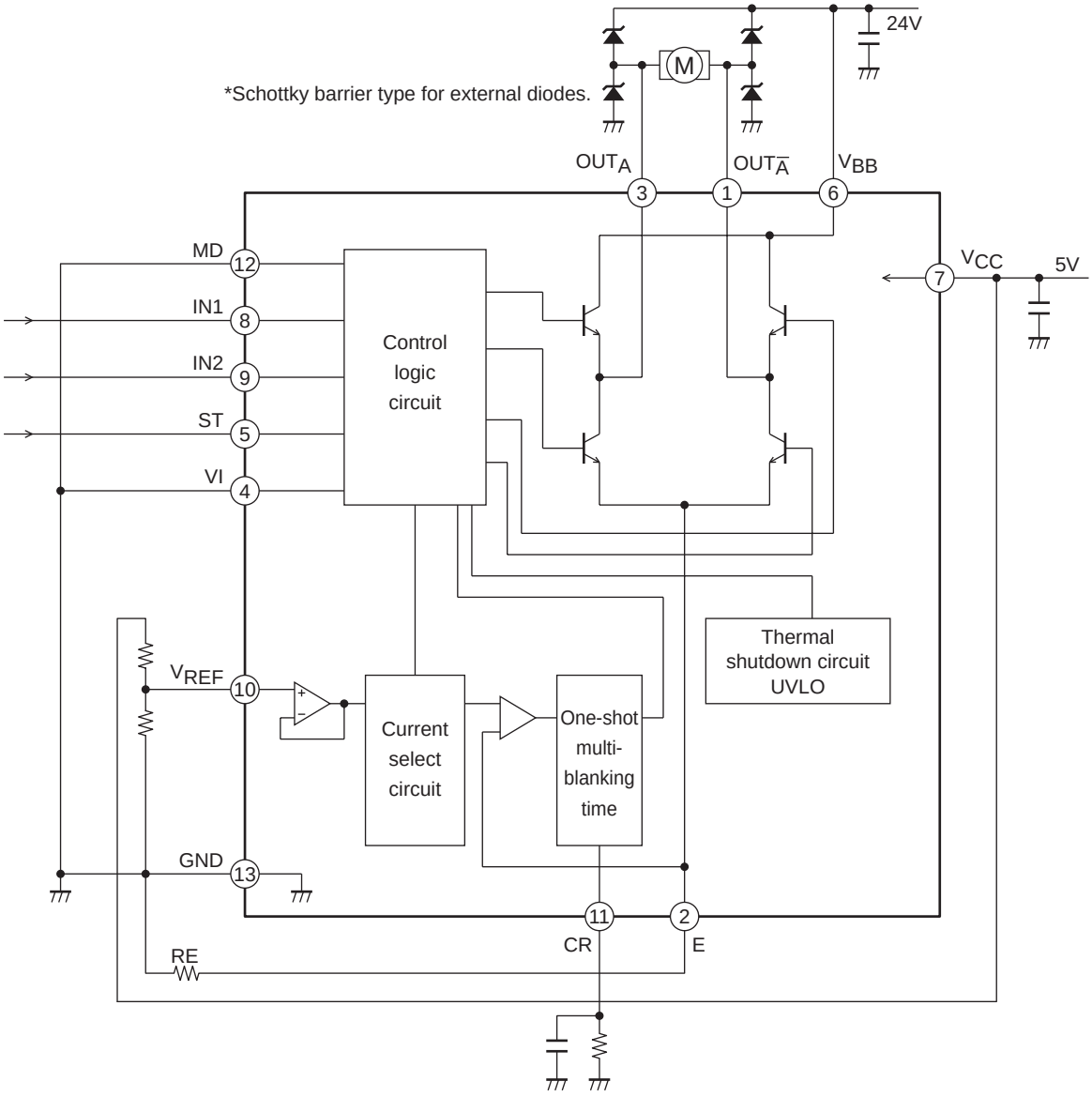
Except for MD pin, Low at input OPEN. MD M: determined by external voltage.

Pin Function

Pin No.	Pin name	Function	Equivalent circuit
1 3	OUT_A $OUT_{\overline{A}}$	Output pin.	
2	E	Sense voltage control pin.	
4	VI	High: sense voltage is 2/5 of V_{REF} Low: sense voltage is 1/5 of V_{REF}	
5	ST	High: circuit operation ON Low: standby mode	
8	IN1	High: rotation mode Low: brake mode	
9	IN2	High: reverse mode Low: forward mode	
6	V_{BB}	Motor power supply voltage.	
7	V_{CC}	Logic power supply voltage.	
10	V_{REF}	Output current setting reference pin. Setting range: 0 to (V_{CC}–2V)	
11	CR	Oscillator with self-excitation.	
12	MD	Current attenuation switching pin. Low : FAST DECAY High: SLOW DECAY M : MIX DECAY M is set by external power supply voltage. Range : 1.1 to 4.0V	
13	GND	Ground pin	

Sample Application Circuits

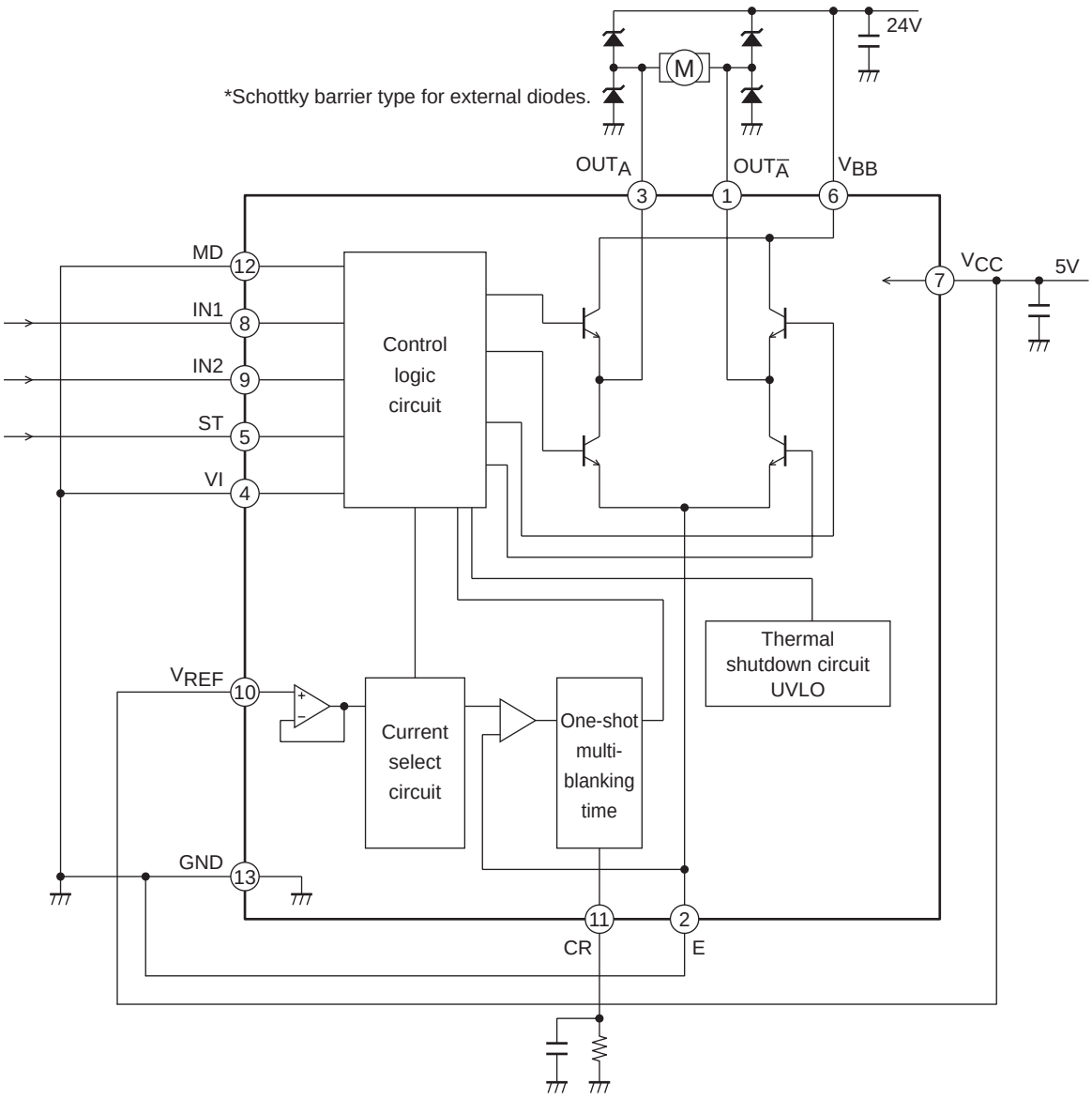
1. Forward/reverse motor with current limiter



Limiter current setting method $I = V_{REF}/ (5 \times RE)$

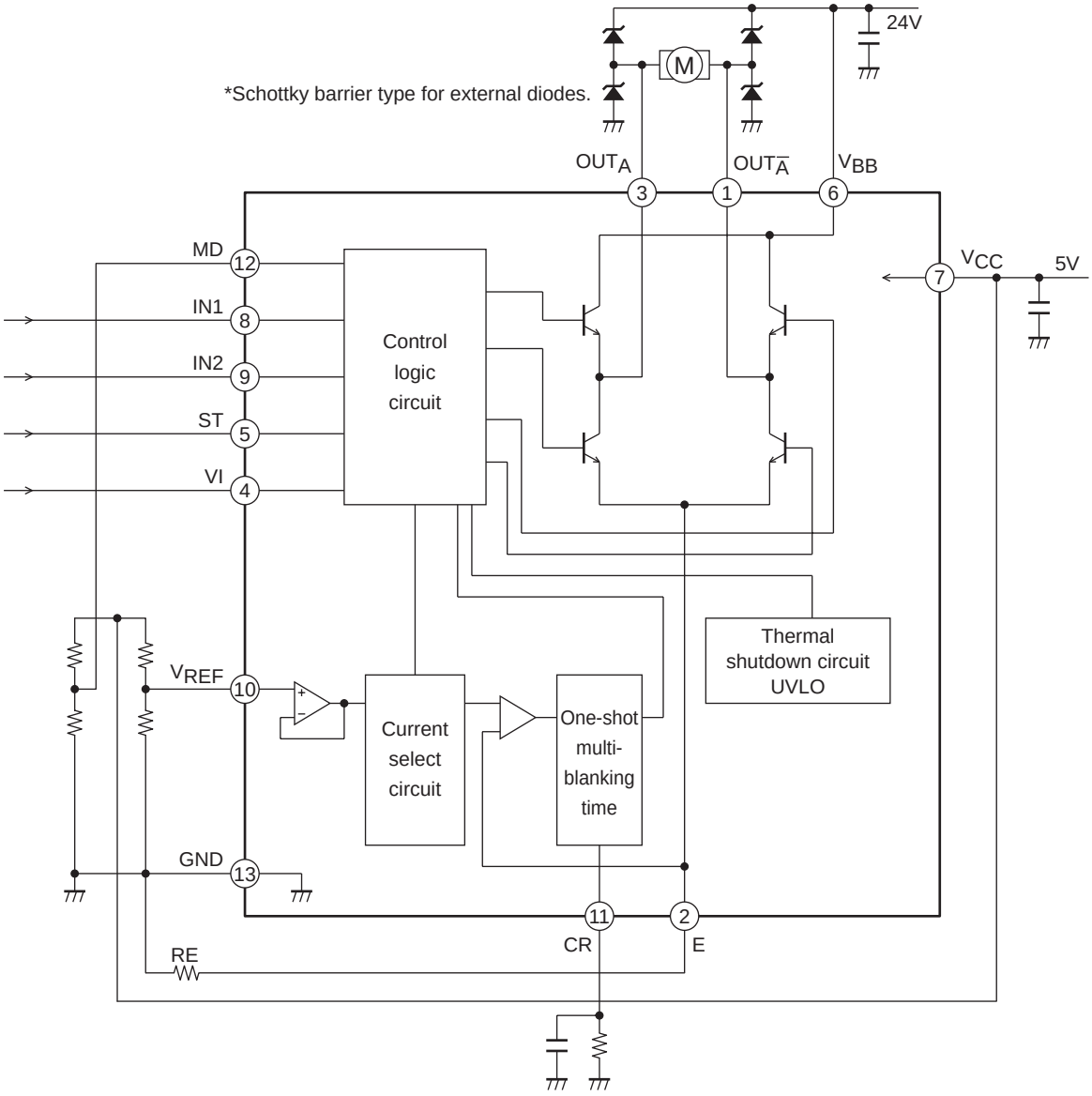
IN1	IN2	ST	OUT_A	$OUT_{\overline{A}}$	Mode
H	L	H	H	L	Forward
H	H	H	L	H	Reverse
L	H	H	L	L	Brake
L	L	H	OFF	OFF	Output OFF
–	–	L	OFF	OFF	Standby mode

2. Forward/reverse motor



IN1	IN2	ST	OUT_A	$OUT_{\overline{A}}$	Mode
H	L	H	H	L	Forward
H	H	H	L	H	Reverse
L	H	H	L	L	Brake
L	L	H	OFF	OFF	Output OFF
–	–	L	OFF	OFF	Standby mode

3. PWM current control forward/reverse motor (MIX DECAY)



Notes on Usage

1. VREF pin
   Because the VREF pin serves for input of the set current reference voltage, precautions against noise must be taken.

2. GND pin
   The ground circuit for this IC must be designed so as to allow for high-current switching. Blocks where high current flows must use low-impedance patterns and must be removed from small-signal lines. Especially the ground connection for the sensing resistor RE at pin E, and the ground connection for the Schottky barrier diodes should be in close proximity to the IC ground.
   The capacitors between V_{CC} and ground, and V_{BB} and ground should be placed close to the V_{CC} and V_{BB} pins, respectively.

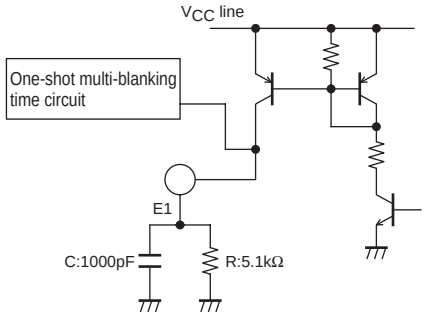
3. CR pin setting (Switching off time, Noise cancel time)
   The noise cancel time (Tn) and the switching off time (Toff) are set by the following expressions:

   Noise cancel time: $Tn \approx C \times R \times \ln \{(1.0 - RI) / (4.0 - RI)$ [sec]

   CR charge current: 1.3mA

   Switching off time: $Toff \approx -C \times R \times \ln (1.0 / 4.8)$ [sec]

   Internal configuration at CR pin



   CR constant range: R = 4.7k to 100kΩ
   C = 330pF to 2200pF