



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

LB1947VC

Monolithic Digital IC

PWM Current Control Type

Forward/Reverse Motor Driver

Overview

The LB1947VC is a PWM current control type forward/reverse motor driver IC. The IC is optimal for use in driving brushed DC motors for printers.

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 $T_a = 25^\circ\text{C}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum motor supply voltage	$V_{BB \text{ max}}$		50	V
Output peak current	$I_O \text{ peak}$	$t_w \leq 20\mu\text{s}$	2.25	A
Output continuous current	$I_O \text{ max}$		2.0	A
Logic supply voltage	$V_{CC \text{ max}}$		7.0	V
Logic input voltage range	V_{IN}		-0.3 to V_{CC}	V
Emitter output voltage	$V_E \text{ max}$		1.1	V
Reference voltage	V_{REF}		-0.3 to V_{CC}	V
Allowable power dissipation	$P_d \text{ max}$	Independent IC	1.3	W
Operating temperature	T_{opr}		-20 to +85	$^\circ\text{C}$
Storage temperature	T_{stg}		-55 to +150	$^\circ\text{C}$

Caution 1) Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

Caution 2) Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment. The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for new introduction or other application different from current conditions on the usage of automotive device, communication device, office equipment, industrial equipment etc. , please consult with us about usage condition (temperature, operation time etc.) prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

SANYO Semiconductor Co., Ltd.

<http://semicon.sanyo.com/en/network>

LB1947VC

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 _O 1(leak)	V _O = V _{BB} , Sink			50	μA
	I _O 2(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
Logic pin input voltage (ST, IN1, IN2, VI)	V _{INH}	High level voltage	2			V
	V _{INL}	Low level voltage			0.8	V
Logic pin input current (ST, IN1, IN2, VI)	I _{INH}	V _{IN} = 5V	60	90	120	μA
	I _{INL}	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	I _{ref}	V _{REF} = 1.0V	-0.5		+0.5	μA
CR pin current	I _{CR}	CR = 1.0V	-1.56	-1.3	-1.04	mA
MD pin input voltage	V _{MDH}	High level voltage	V _{CC} -0.3			V
	V _{MDM}	Middle level voltage	0.3V _{CC}		V _{CC} -1.0	V
	V _{MDL}	Low level voltage			.04	V
MD pin input current	I _{MDH}	MD = V _{CC} -0.5V, CR = 1.0V	-1.0		+1.0	μA
	I _{MDL}	MD = 0.4V, CR = 2.0V	-5.0			μA
Thermal shutdown temperature	TSD	Design guarantee value*		170		°C

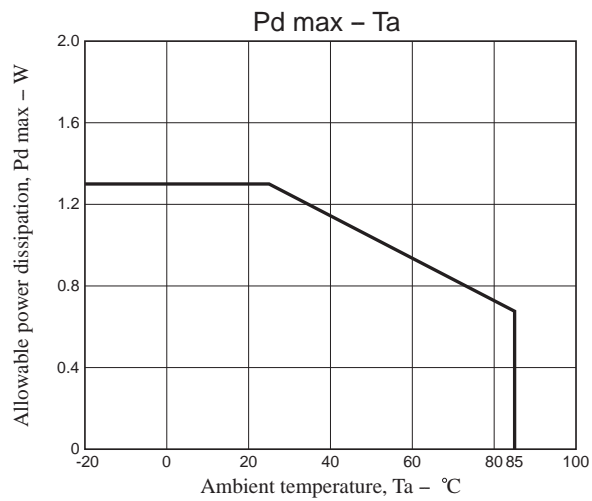
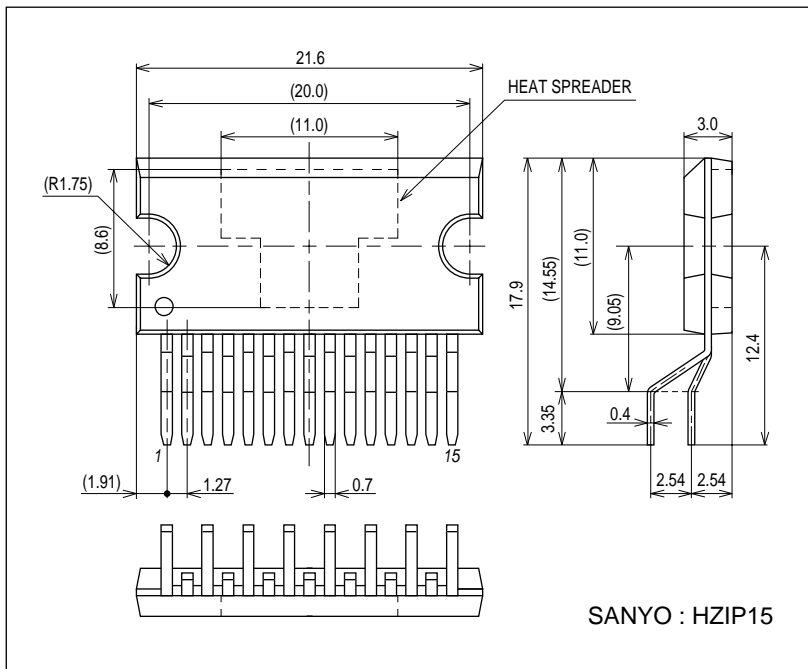
* Design guarantee value, Do not measurement.

LB1947VC

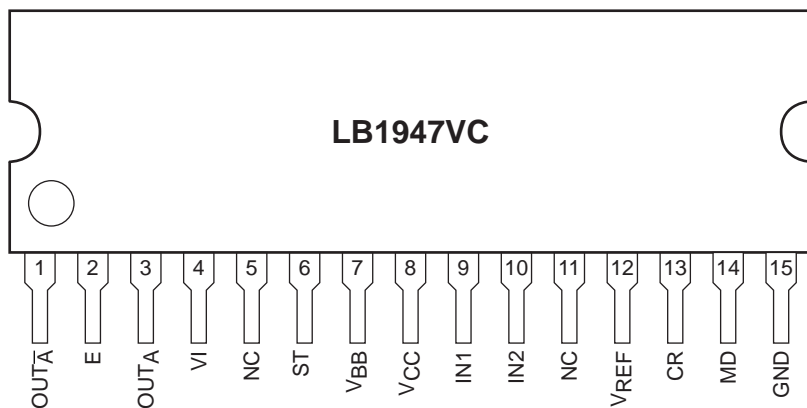
Package Dimensions

unit : mm (typ)

3336



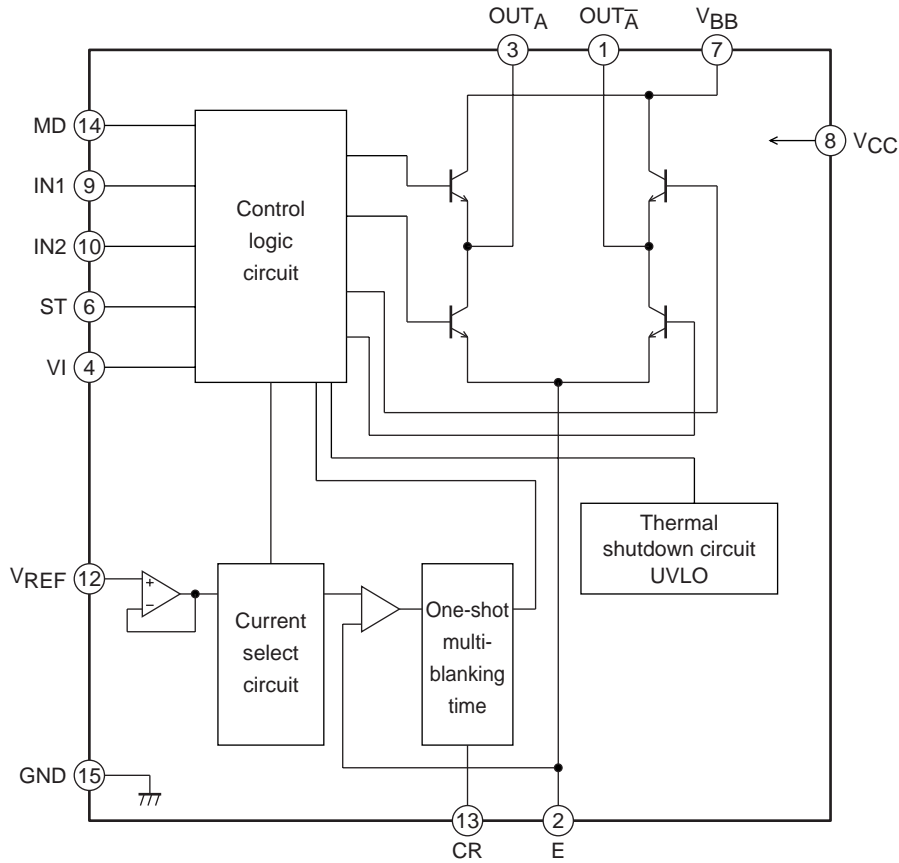
Pin Assignment



Top view

LB1947VC

Block Diagram



Truth Table

IN1	IN2	ST	VI	MD	OUT _A	OUT _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.

LB1947VC

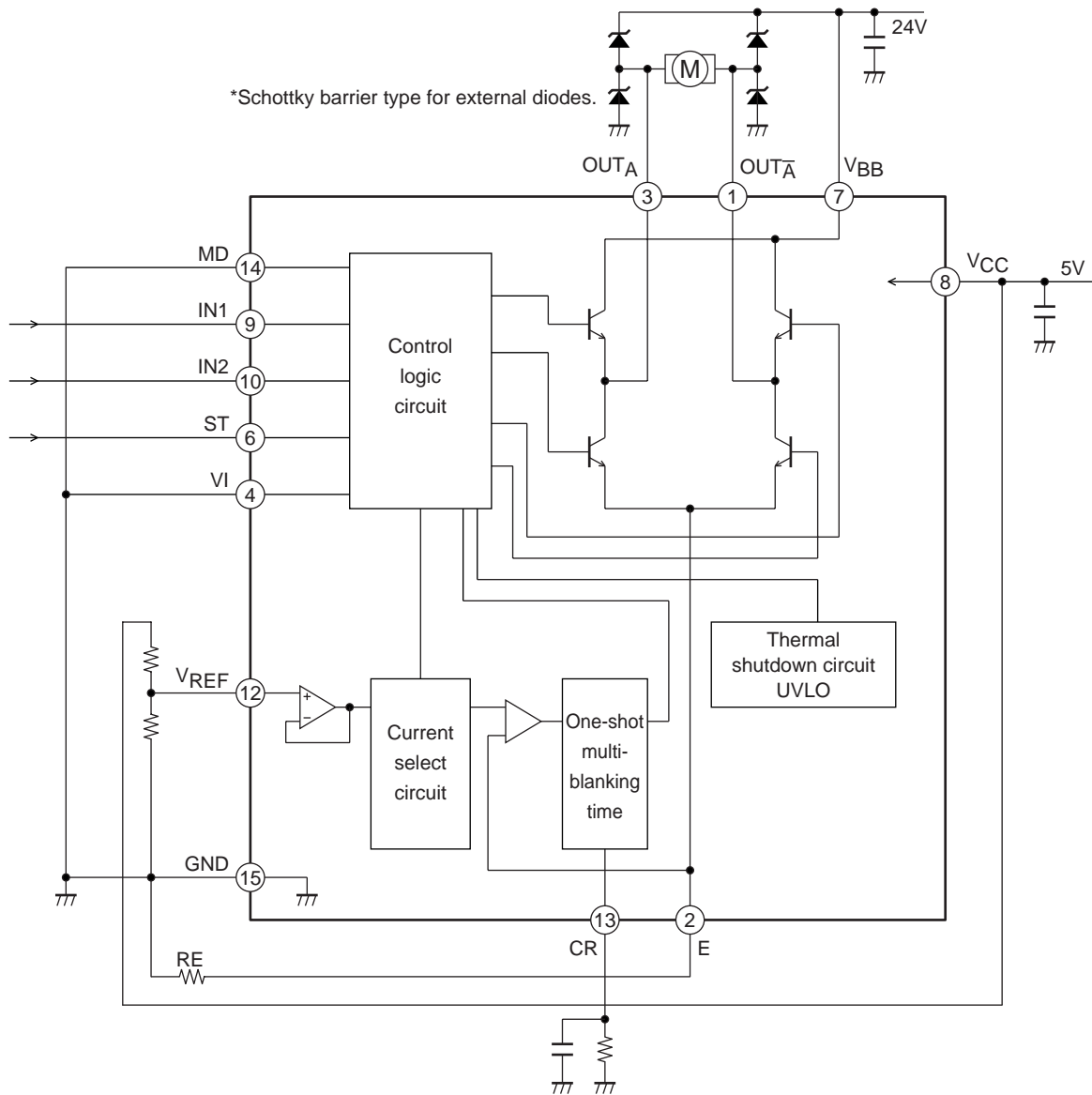
Pin Function

Pin No.	Pin name	Function	Equivalent circuit
1 3	OUT _A OUT _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}	
6	ST	High: circuit operation ON Low: standby mode	
9	IN1	High: rotation mode Low: brake mode	
10	IN2	High: reverse mode Low: forward mode	
7	V _{BB}	Motor power supply voltage.	
8	V _{CC}	Logic power supply voltage.	
12	V _{REF}	Output current setting reference pin. Setting range: 0 to (V _{CC} -2V)	
13	CR	Oscillator with self-excitation.	
14	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	
15	GND	Ground pin	
5, 11	NC	No connect	

LB1947VC

Sample Application Circuits

1. Forward/reverse motor with current limiter



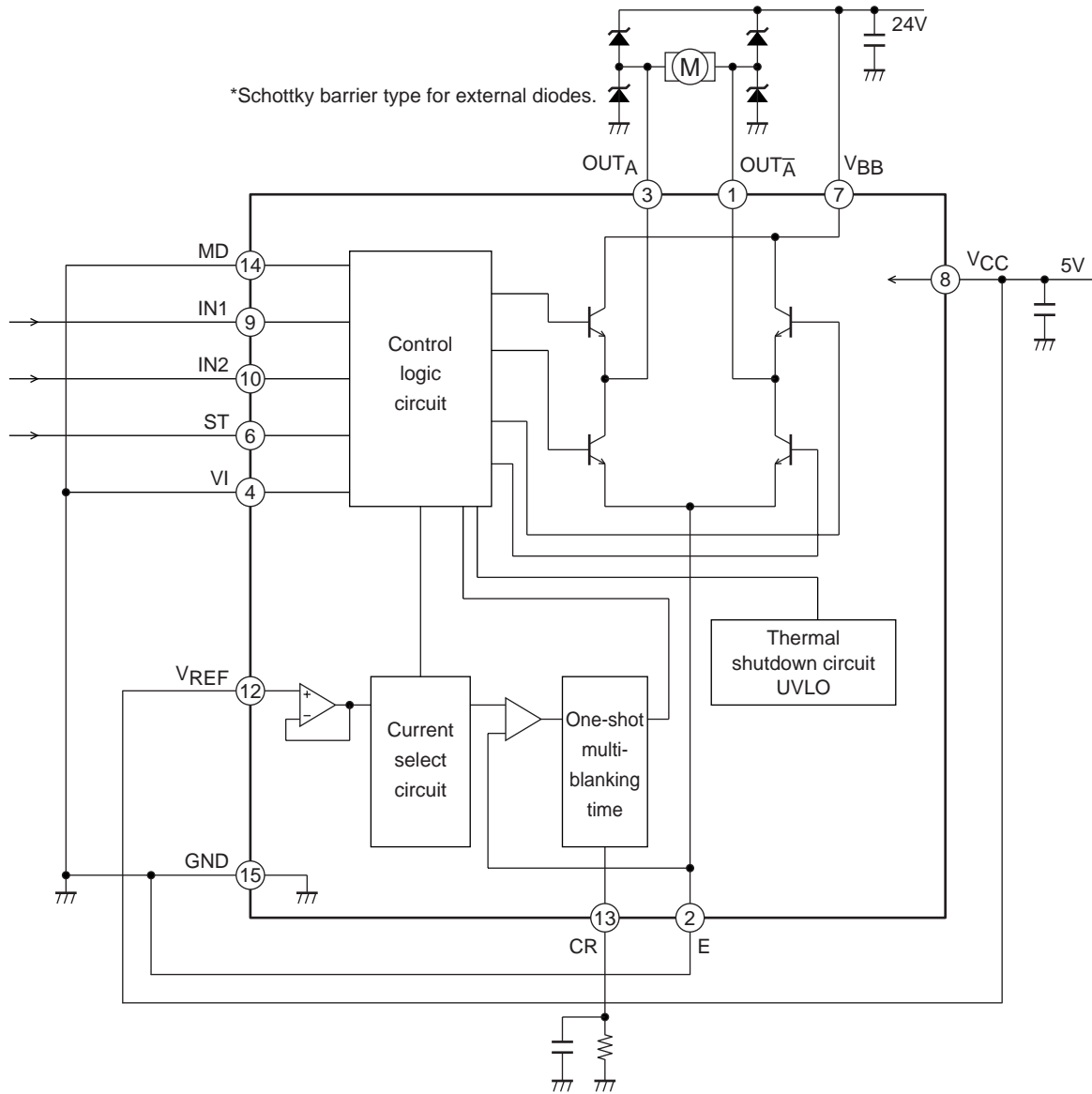
Limiter current setting method

$$I = V_{REF} / (5 \times RE)$$

IN1	IN2	ST	OUT _A	OUT _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

LB1947VC

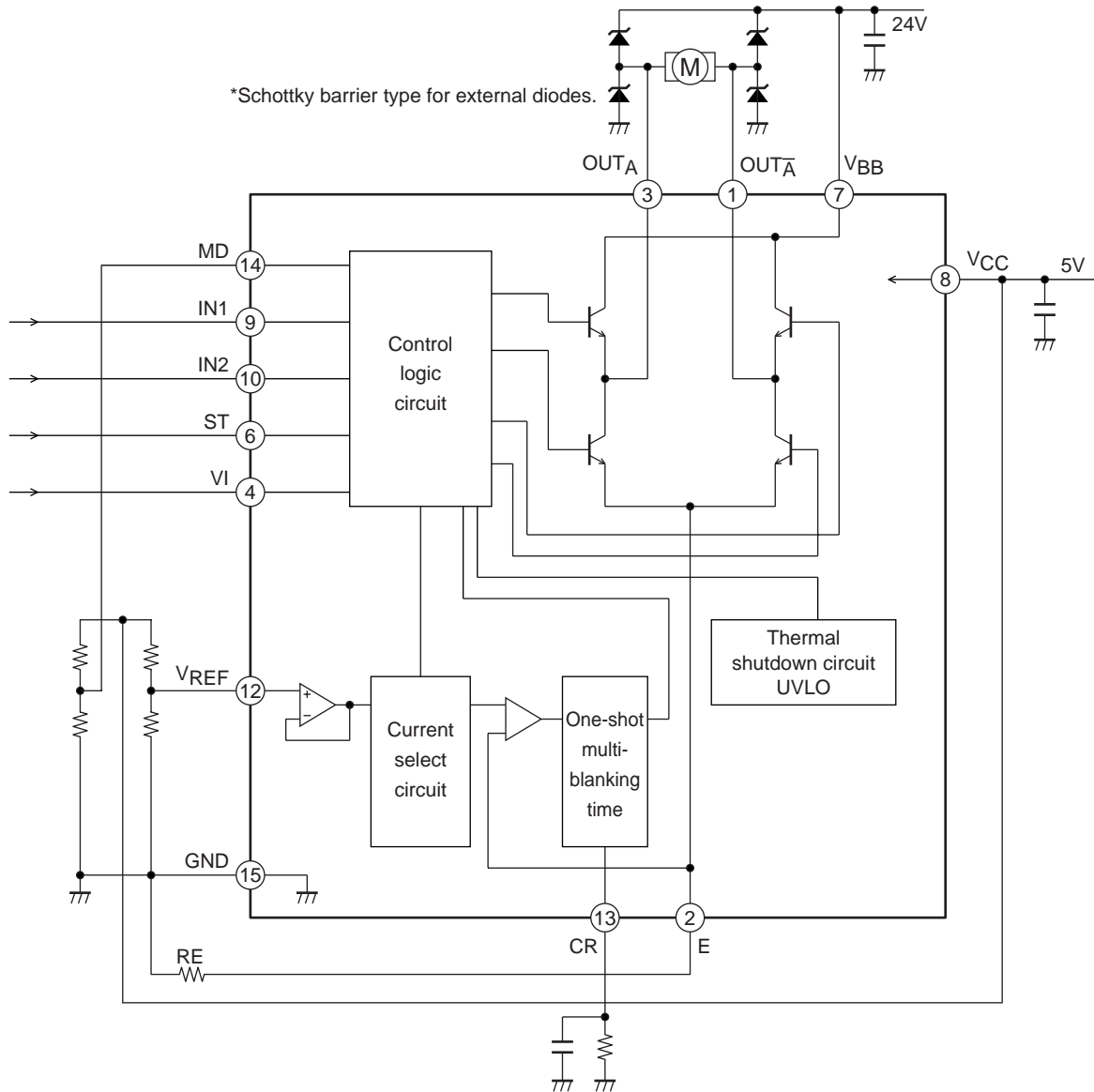
2. Forward/reverse motor



IN1	IN2	ST	OUT _A	OUT _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

LB1947VC

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 VCC and ground, and VBB and ground should be placed close to the VCC and VBB pins, respectively.

3. CR pin setting (Switching off time, Noise cancel time)

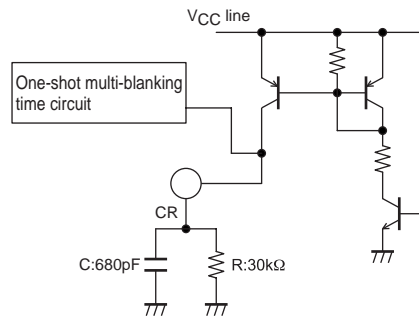
The noise cancel time (Tn) and the switching off time (Toff) are set by the following expressions:

$$\text{Noise cancel time: } T_n \approx C \times R \times \ln \left\{ \frac{(1.0 - RI)}{(4.0 - RI)} \right\} [\text{sec}]$$

CR charge current: 1.3mA

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

Internal configuration at CR pin



CR constant range: R = 4.7k to 100kΩ

C = 330pF to 2200pF

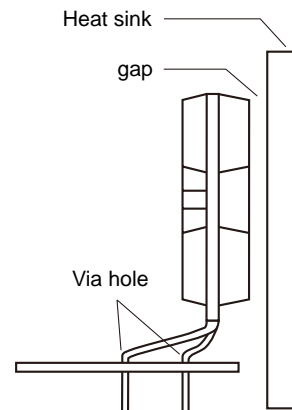
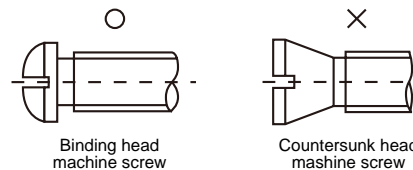
Heat sink attachment

Heat sinks are used to lower the semiconductor device junction temperature by leading the heat generated by the device to the outer environment and dissipating that heat.

- a. Unless otherwise specified, for power ICs with tabs and power ICs with attached heat sinks, solder must not be applied to the heat sink or tabs.

b. Heat sink attachment

- Use flat-head screws to attach heat sinks.
- Use also washer to protect the package.
- Use tightening torques in the ranges 39-59Ncm(4-6kgcm) .
- If tapping screws are used, do not use screws with a diameter larger than the holes in the semiconductor device itself.
- Do not make gap, dust, or other contaminants to get between the semiconductor device and the tab or heat sink.
- Take care a position of via hole .
- Do not allow dirt, dust, or other contaminants to get between the semiconductor device and the tab or heat sink.
- Verify that there are no press burrs or screw-hole burrs on the heat sink.
- Warping in heat sinks and printed circuit boards must be no more than 0.05 mm between screw holes, for either concave or convex warping.
- Twisting must be limited to under 0.05 mm.
- Heat sink and semiconductor device are mounted in parallel.
Take care of electric or compressed air drivers
- The speed of these torque wrenches should never exceed 700 rpm, and should typically be about 400 rpm.



c. Silicone grease

- Spread the silicone grease evenly when mounting heat sinks.
- Sanyo recommends YG-6260 (Momentive Performance Materials Japan LLC)

d. Mount

- First mount the heat sink on the semiconductor device, and then mount that assembly on the printed circuit board.
- When attaching a heat sink after mounting a semiconductor device into the printed circuit board, when tightening up a heat sink with the screw, the mechanical stress which is impossible to the semiconductor device and the pin doesn't hang.

e. When mounting the semiconductor device to the heat sink using jigs, etc.,

- Take care not to allow the device to ride onto the jig or positioning dowel.
- Design the jig so that no unreasonable mechanical stress is not applied to the semiconductor device.

f. Heat sink screw holes

- Be sure that chamfering and shear drop of heat sinks must not be larger than the diameter of screw head used.
- When using nuts, do not make the heat sink hole diameters larger than the diameter of the head of the screws used. A hole diameter about 15% larger than the diameter of the screw is desirable.
- When tap screws are used, be sure that the diameter of the holes in the heat sink are not too small. A diameter about 15% smaller than the diameter of the screw is desirable.

- g. There is a method to mount the semiconductor device to the heat sink by using a spring band. But this method is not recommended because of possible displacement due to fluctuation of the spring force with time or vibration.

- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of March, 2012. Specifications and information herein are subject to change without notice.