

Ordering number : ENN\*6192

Monolithic Digital IC



# LB1947

## PWM Current Control Type DC Motor Driver

### Preliminary

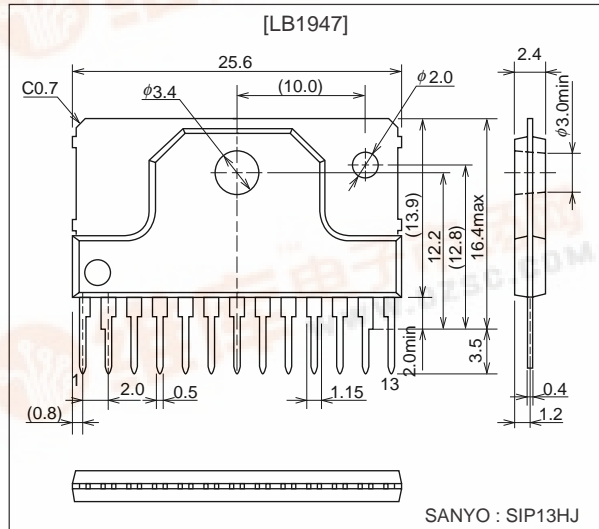
#### Features

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

#### Package Dimensions

unit: mm

3249-SIP13HJ



### Specifications

#### Absolute Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum motor supply voltage	V <sub>BB</sub> max		50	V
Output peak current	I <sub>OPEAK</sub>	tw ≤ 20 μs	2.25	A
Output continuous current	I <sub>O</sub> max		2.0	A
Logic supply voltage	V <sub>CC</sub> max		7.0	V
Logic input voltage range	V <sub>IN</sub>		-0.3 to V <sub>CC</sub>	V
Emitter output voltage	V <sub>E</sub> max		1.1	V
Reference voltage	V <sub>REF</sub>		-0.3 to V <sub>CC</sub>	V
Operating temperature	T <sub>opr</sub>		-20 to +85	°C
Storage temperature	T <sub>stg</sub>		-55 to +150	°C
Allowable power dissipation	P <sub>d</sub> max	Ta = 25°C	1.6	W

#### Allowable Operating Ranges at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Motor supply voltage	V <sub>BB</sub>		10 to 45	V
Logic supply voltage	V <sub>CC</sub>		4.75 to 5.25	V
Reference voltage	V <sub>REF</sub>		0 to (V <sub>CC</sub> -2)	V

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**Electrical Characteristics at Ta = 25°C, V<sub>BB</sub> = 42V, V<sub>CC</sub> = 5V, V<sub>REF</sub> = 1.0V**

Parameter	Symbol	Conditions	Ratings			Unit	
			min	typ	max		
Output Block	Output stage supply current	I <sub>BB ON</sub>	No-load state	0.4	0.6	1.0	mA
		I <sub>BB BR</sub>	No-load state	0.2	0.4	0.8	mA
		I <sub>BB OFF</sub>	No-load state	0.2	0.4	0.8	mA
		I <sub>BBWt</sub>	No-load state			0.1	mA
	Output saturation voltage 1	V <sub>osat 1</sub>	Io = +1.0A sink		1.2	1.5	V
		V <sub>osat 2</sub>	Io = +2.0A sink		1.6	1.9	V
		V <sub>osat 3</sub>	Io = -1.0A source		1.8	2.2	V
		V <sub>osat 4</sub>	Io = -2.0A source		2.1	2.4	V
	Output leak current	I <sub>o1(leak)</sub>	Vo = V <sub>BB</sub> sink			50	μA
		I <sub>o2(leak)</sub>	Vo = 0V source	-50			μA
Output sustain voltage	V <sub>SUS</sub>	L = 3.9 mH Io = 2.0A *1	50			V	
Logic Block	Logic supply current	I <sub>CC ON</sub>	IN1 : High, IN2 : Low, ST = High	11	16	21	mA
		I <sub>CC BR</sub>	IN1 : Low, IN2 : High, ST = High	11	16	21	mA
		I <sub>CC OFF</sub>	IN1 : Low, IN2 : Low, ST = High	11	16	21	mA
		I <sub>CCWt</sub>	ST : Low	1.0	2	3.0	mA
	Input voltage	V <sub>INH</sub>		2			V
		V <sub>INL</sub>				0.8	V
	Input current	I <sub>INH</sub>	V <sub>IN</sub> = 5V	60	90	120	μA
		I <sub>INL</sub>	V <sub>IN</sub> = 0.8V	6	10	13	μA
	Sensing voltage	V <sub>E</sub>		0		1.1	V
	Sensing voltage 25H	V <sub>EH25</sub>	VI = High, V <sub>REF</sub> = 2.5V	0.970	1.0	1.030	V
	Sensing voltage 25L	V <sub>EL25</sub>	VI = Low, V <sub>REF</sub> = 2.5V	0.483	0.5	0.513	V
	Sensing voltage 10H	V <sub>EH25</sub>	VI = High, V <sub>REF</sub> = 1.0V	0.385	0.4	0.410	V
	Sensing voltage 10L	V <sub>EL25</sub>	VI = Low, V <sub>REF</sub> = 1.0V	0.190	0.2	0.210	V
	Sensing voltage 05H	V <sub>EH25</sub>	VI = High, V <sub>REF</sub> = 0.5V	0.190	0.2	0.210	V
	Sensing voltage 05L	V <sub>EL25</sub>	VI = Low, V <sub>REF</sub> = 0.5V	0.092	0.1	0.108	V
	Reference current	I <sub>ref</sub>	V <sub>ref</sub> = 1.0V	-0.5		0.5	μA
	CR pin current	I <sub>CR</sub>	CR = 1.0V	-1.56	-1.3	-1.04	mA
	MD pin voltage	V <sub>MDH</sub>		V <sub>CC</sub> -0.3			V
		V <sub>MDM</sub>		0.3V <sub>CC</sub>		V <sub>CC</sub> -1.0	V
		V <sub>MDL</sub>				0.4	V
MD pin current	I <sub>MDH</sub>	MD = (V <sub>CC</sub> -0.5)V, CR = 1.0V	-1.0		1.0	μA	
	I <sub>MDL</sub>	MD = 0.4V, CR = 2.0V	-5.0			μA	
Thermal shutdown temperature	T <sub>SD</sub>			170		°C	

\*1: Guaranteed design

### Truth Table

IN 1	IN 2	ST	VI	MD	OUT	OUT-	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

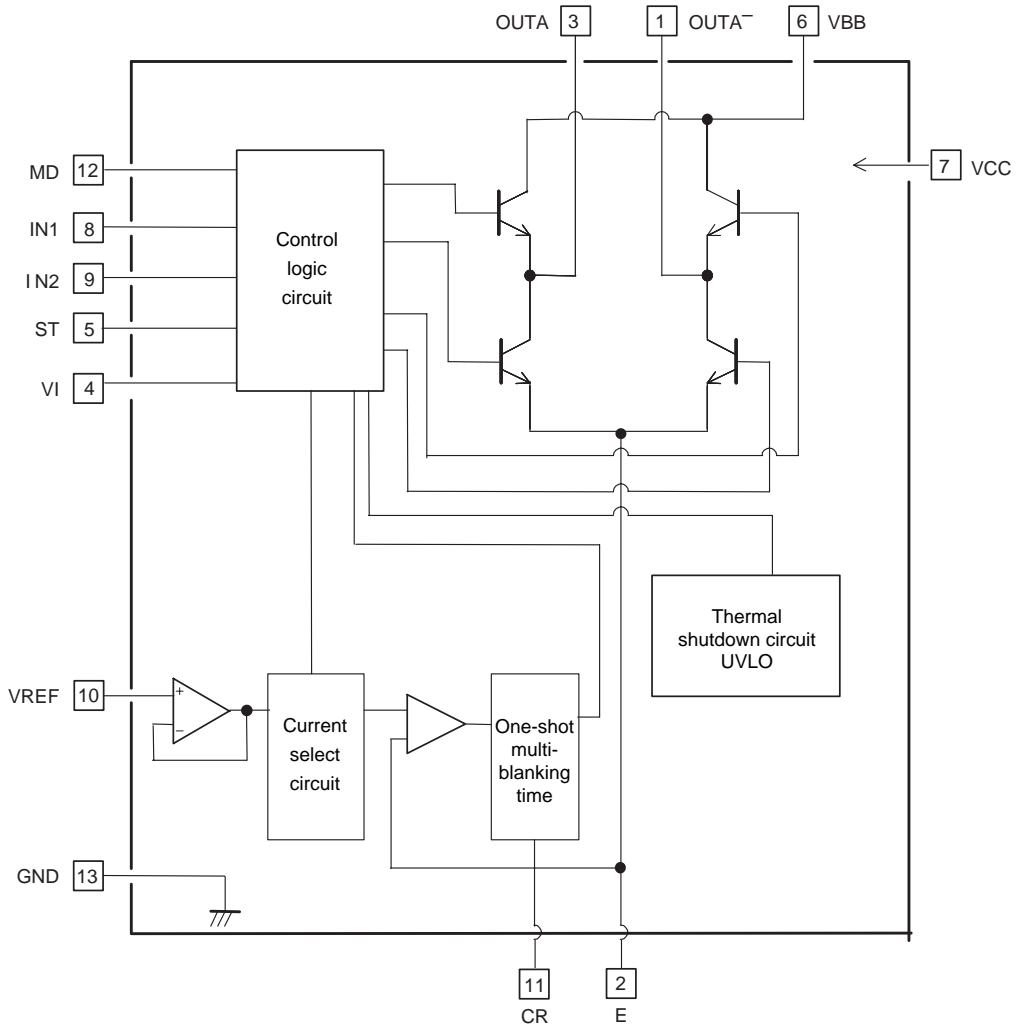
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## Pin Description

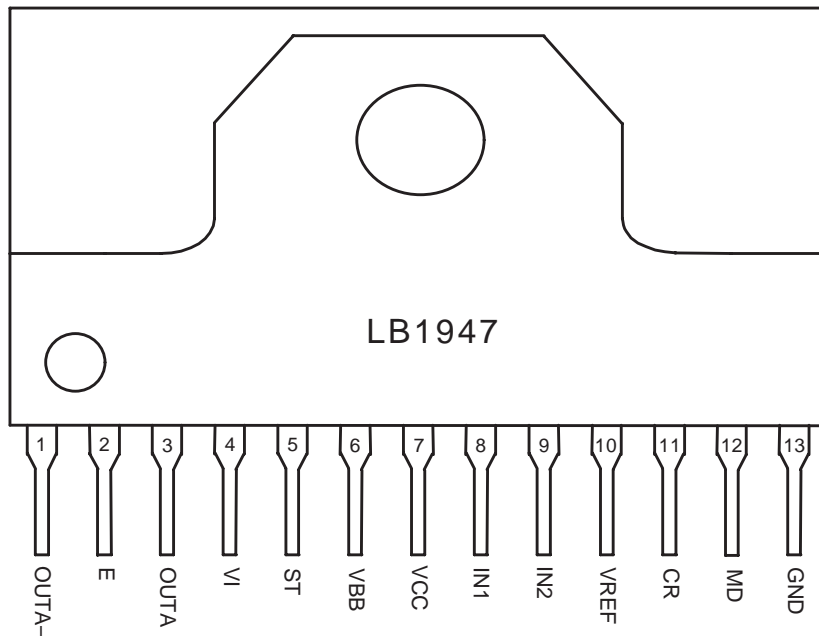
Pin number	Pin name	Equivalent circuit	Pin function
1 3	OUTA– OUTA		Output pin
2	E		Sense voltage control pin
4 5 8 9	VI ST IN1 IN2		<p>VI</p> <p>High : sense voltage is 2/5 of <math>V_{REF}</math> Low : sense voltage is 1/5 of <math>V_{REF}</math></p> <p>ST</p> <p>High : circuit operation ON Low : standby mode</p> <p>IN1</p> <p>High : rotation mode Low : brake mode</p> <p>IN2</p> <p>High : reverse mode Low : forward mode</p>
6	VBB		Motor power supply voltage
7	VCC		Logic power supply voltage
10	VREF		<p>Output current setting reference pin</p> <p>Setting range: 0 to (<math>V_{CC}-2V</math>)</p>
11	CR		Oscillator with self-excitation
12	MD		<p>Current attenuation switching pin</p> <p>Low : FAST DECAY High : SLOW DECAY M : MIX DECAY</p> <p>M is set by external power supply voltage. Range : 1.1 to 4.0V</p>
13	GND		Ground pin

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## Block Diagram



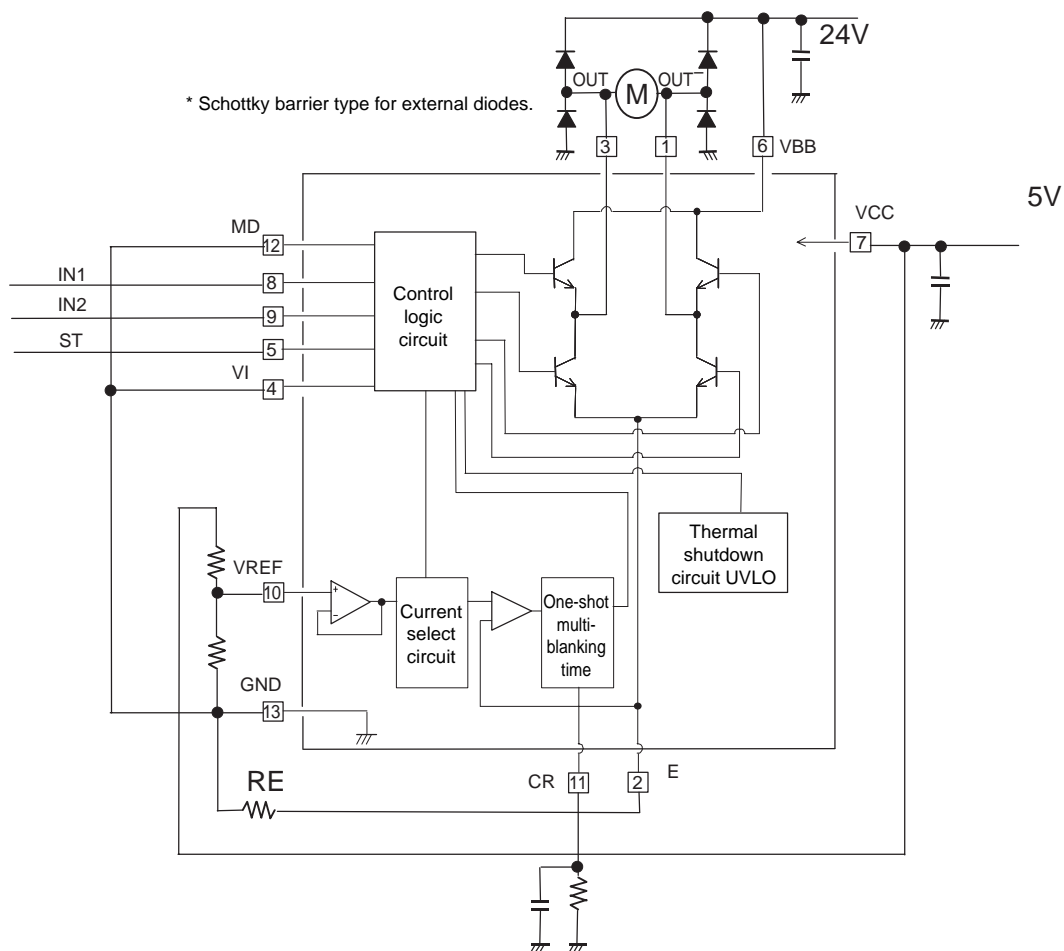
## Pin Assignment



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## Sample Application Circuits

### 1. Forward/reverse motor with current limiter

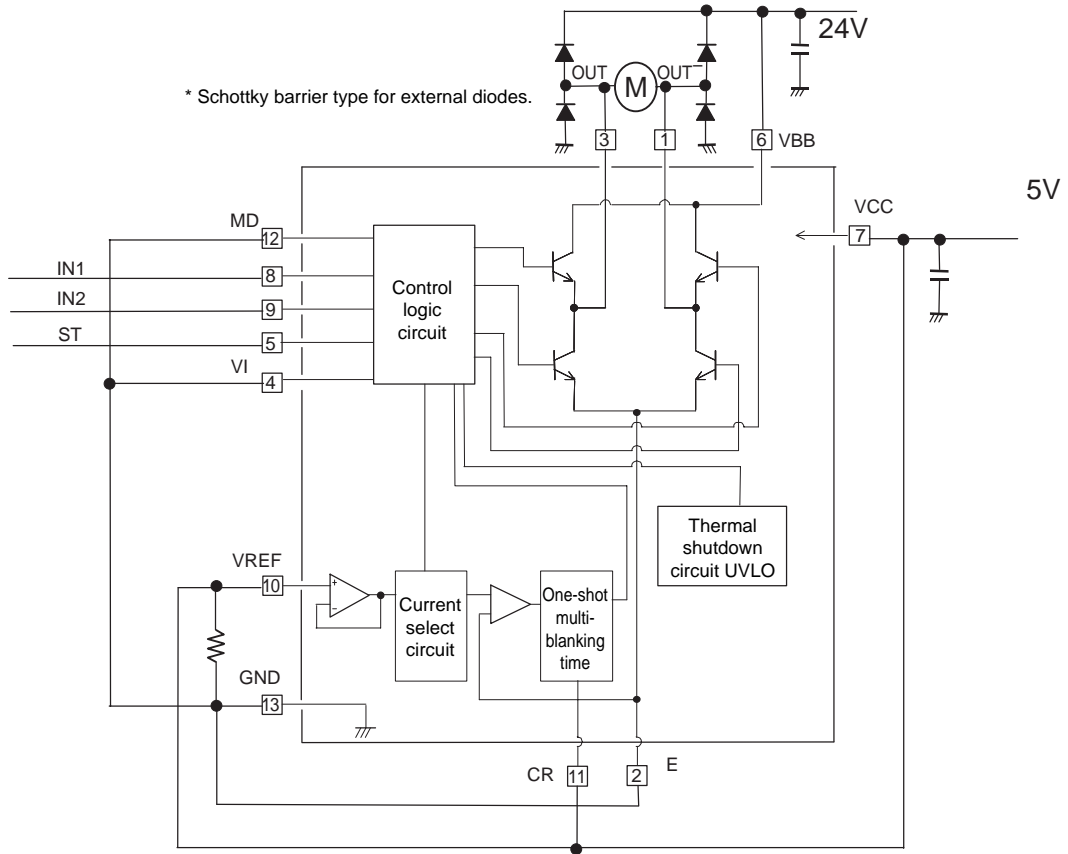


Limiter current setting method  $I = V_{REF} / (5 \times RE)$

IN1	IN2	ST	OUT	OUT-	Mode
H	H	H	L	H	Reverse
H	L	H	H	L	Forward
L	H	H	L	L	Brake
L	L	H	OFF	OFF	Output OFF
-	-	L	OFF	OFF	Standby mode

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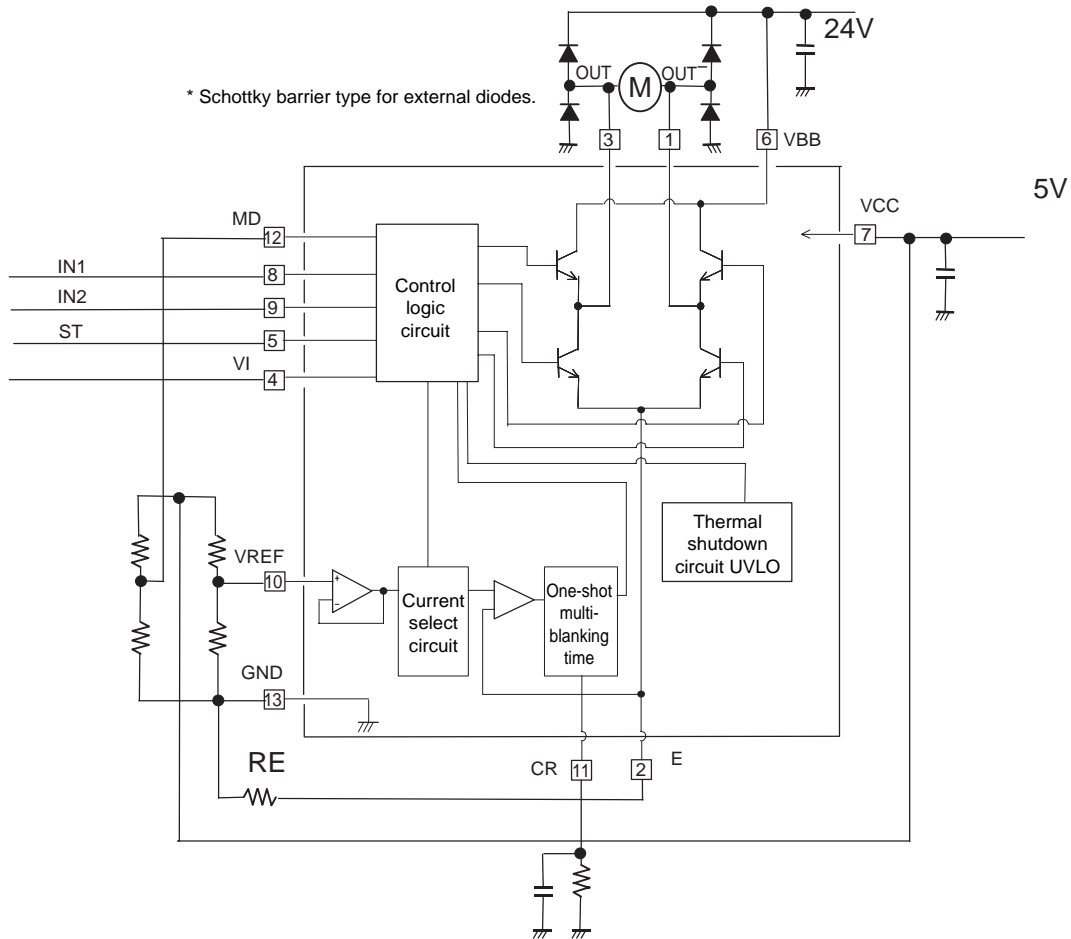
## 2. Forward/reverse motor



IN1	IN2	ST	OUT	OUT-	Mode
H	H	H	L	H	Reverse
H	L	H	H	L	Forward
L	H	H	L	L	Brake
L	L	H	OFF	OFF	Output OFF
-	-	L	OFF	OFF	Standby mode

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



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