

LB11620GP

Three-Phase Direct PWM Brushless Motor Driver

Overview

The LB11620GP is a direct PWM drive pre-driver IC that is optimal for three-phase power brushless motors. A motor driver circuit with the desired output capability (voltage and current) can be implemented by adding discrete transistors or other power devices to the outputs of this IC. Since the LB11620GP is provided in a miniature package, it is also appropriate for use with miniature motors as well.

Features

- Three-phase bipolar drive
- Direct PWM drive (input of either a control voltage or a variable-duty PWM signal)
- Built-in forward/reverse switching circuit
- 5V regulator output (VREG pin)
- Built-in current limiter circuit (0.25V (typical) reference voltage)
- Built-in under voltage protection circuit
- Built-in automatic recovery type constraint protection circuit (ON: OFF=1: 18) with protection operating state discrimination output (RD pin)
- Hall signal pulse outputs

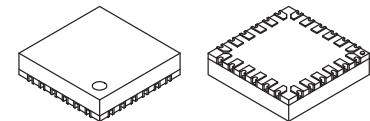
Typical Applications

- Server
- Home appliance



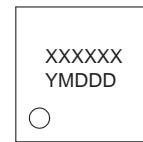
ON Semiconductor®

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VCT24 (3.5x3.5)

GENERIC MARKING DIAGRAM*



XXXXXX = Specific Device Code

Y = Year

M = Month

DDD = Additional Traceability Data

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "■", may or may not be present.

ORDERING INFORMATION

Ordering Code:
LB11620GP-TE-L-H

Package
VCT24
(Pb-Free / Halogen Free)

Shipping (Qty / packing)
2000 / Tape & Reel

† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
http://www.onsemi.com/pub_link/Collateral/BRD8011-D.PDF

Specifications

MAXIMUM RATINGS / Ta = 25°C (Note 1)

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V _{CC} max	V _{CC} pin	18	V
Output current	I _O max	UL, VL, WL, UH, VH, WH pins	30	mA
Allowable power dissipation	P _d max	*Mounted on a circuit board.	1.0	W
Operating temperature	T _{opr}		-30 to +100	°C
Storage temperature	T _{stg}		-55 to +150	°C

1. Stresses exceeding those listed in the Absolute Maximum Rating table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

2. Mounted on a circuit board: 40.0mm×50.0mm×0.8mm, glass epoxy board.

RECOMMENDED OPERATING RANGES at Ta = 25°C (Note 3)

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage range 1-1	V _{CC1-1}	V _{CC} pin	8 to 17	V
Supply voltage range 1-2	V _{CC1-2}	V _{CC} pin, with V _{CC} shorted to V _{REG}	4.5 to 5.5	V
Output current	I _O	UL, VL, WL, UH, VH, WH pins	25	mA
5 V constant voltage output current	I _{REG}		-30	mA
HP pin voltage	V _{HP}		0 to 17	V
HP pin output current	I _{HP}		0 to 15	mA
RD pin voltage	V _{RD}		0 to 17	V
RD pin output current	I _{RD}		0 to 15	mA

3. Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

ELECTRICAL CHARACTERISTICS at Ta = 25°C, V_{CC} = 12V (Note 4)

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage 1	I _{CC1}			12	16	mA
5V constant voltage output (V_{REG} pin)						
Output voltage	V _{REG}		4.7	5.0	5.3	V
Line regulation	ΔV _{REG1}	V _{CC} = 8 to 17V		40	100	mV
Load regulation	ΔV _{REG2}	I _O = -5 to -20mA		10	30	mV
Temperature coefficient	ΔV _{REG3}	Design target		0		mV/°C
Low-voltage protection circuit (V_{REG} pin)						
Operating voltage	V _{SDL}		3.5	3.7	3.9	V
Clear voltage	V _{SDH}		3.95	4.15	4.35	V
Hysteresis	ΔV _{SD}		0.3	0.45	0.6	V
Output Block						
Output voltage 1-1	V _{OUT1-1}	Low level I _O = 400μA		0.2	0.5	V
Output voltage 1-2	V _{OUT1-2}	Low level I _O = 10mA		0.9	1.2	V
Output voltage 2	V _{OUT2}	High level I _O = -20mA	V _{CC} -1.1	V _{CC} -0.9		V
Output leakage current	I _O leak				10	μA

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Hall Amplifier Block						
Input bias current	I _{HB} (HA)		-2	-0.5		μA
Common-mode input voltage range 1	V _{ICM1}	When a Hall effect sensor is used	0.5		V _{CC} -2.0	V
Common-mode input voltage range 2	V _{ICM2}	For single-sided input bias (Hall IC application)	0		V _{CC}	V
Hall input sensitivity			80			mV _{p-p}
Hysteresis	ΔV _{IN} (HA)		15	24	40	mV
Input voltage low → high	V _{SLH} (HA)		5	12	20	mV
Input voltage high → low	V _{SHL} (HA)		-20	-12	-5	mV
PWM Oscillator (PWM pin)						
High-level output voltage	V _{OH} (PWM)		2.75	3.0	3.25	V
Low-level output voltage	V _{OL} (PWM)		1.2	1.35	1.5	V
External capacitor charge current	I _{CHG}	V _{PWM} = 2.1V	-120	-90	-65	μA
Oscillator frequency	f (PWM)	C = 2000pF		22		kHz
Amplitude	V (PWM)		1.4	1.6	1.9	V _{p-p}
El+ pin						
Input bias current	I _B (CTL)		-1		1	μA
Common-mode input voltage range	V _{ICM}		0		V _{REG} -1.7	V
Input voltage 1	V _{CTL1}	Output duty 100%		3.0		V
Input voltage 2	V _{CTL2}	Output duty 0%		1.35		V
Input voltage 1L	V _{CTL1L}	Design target value. When V _{REG} = 4.7V, 100%		2.82		V
Input voltage 2L	V _{CTL2L}	Design target value. When V _{REG} = 4.7V, 0%		1.29		V
Input voltage 1H	V _{CTL1H}	Design target value. When V _{REG} = 5.3V, 100%		3.18		V
Input voltage 2H	V _{CTL2H}	Design target value. When V _{REG} = 5.3V, 0%		1.44		V
HP pin						
Output saturation voltage	V _{HPL}	I _O = 10mA		0.2	0.5	V
Output leakage current	I _{HPLeak}	V _O = 18V			10	μA
CSD oscillator (CSD pin)						
High-level output voltage	V _{OH} (CSD)		2.7	3.0	3.3	V
Low-level output voltage	V _{OL} (CSD)		0.7	1.0	1.3	V
External capacitor charge current	I _{CHG1}	V _{CSD} = 2V	-3.15	-2.5	-1.85	μA
External capacitor discharge current	I _{CHG2}	V _{CSD} = 2V	0.1	0.14	0.18	μA
Charge/discharge current ratio	R _{CSD}	Charge current /discharge current	15	18	21	Times
RD pin						
Low-level output voltage	V _{RD}	I _O = 10mA		0.2	0.5	V
Output leakage current	I _L (RD)	V _O = 18V			10	μA
Current limiter circuit (RF pin)						
Limiter voltage	V _{RF}	RF-GND	0.225	0.25	0.275	V
PWMIN pin						
Input frequency	f (PI)				60	kHz
High-level input voltage	V _{IH} (PI)		2.0		V _{REG}	V
Low-level input voltage	V _{IL} (PI)		0		1.0	V
Input open voltage	V _{IO} (PI)		V _{REG} -0.5		V _{REG}	V
Hysteresis	V _{IS} (PI)		0.2	0.25	0.4	V
High-level input current	I _{IH} (PI)	V _{PWMIN} = V _{REG}	-10	0	10	μA
Low-level input current	I _{IL} (PI)	V _{PWMIN} = 0V	-130	-90		μA

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
F/R pin						
High-level input voltage	V_{IH} (FR)		2.0		VREG	V
Low-level input voltage	V_{IL} (FR)		0		1.0	V
Input open voltage	V_{IO} (FR)		VREG-0.5		VREG	V
Hysteresis	V_{IS} (FR)		0.2	0.25	0.4	V
High-level input current	I_{IH} (FR)		-10	0	10	μ A
Low-level input current	I_{IL} (FR)		-130	-90		μ A
N1 pin						
High-level input voltage	V_{IH} (N1)		2.0		VREG	V
Low-level input voltage	V_{IL} (N1)		0		1.0	V
Input open voltage	V_{IO} (N1)		VREG-0.5		VREG	V
High-level input current	I_{IH} (N1)	$V_{N1} = VREG$	-10	0	10	μ A
Low-level input current	I_{IL} (N1)	$V_{N1} = 0V$	-130	-100		μ A

4. Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted.

Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

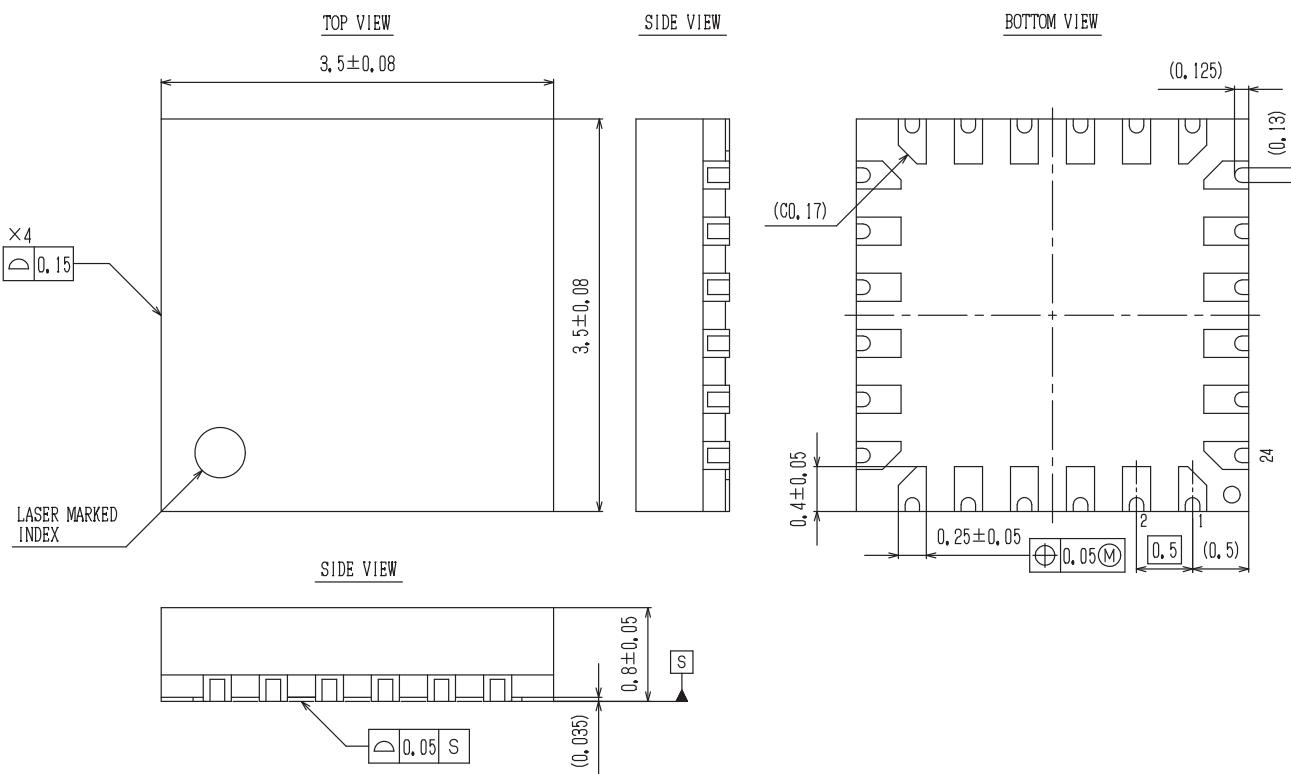
Package Dimensions

unit : mm (typ)

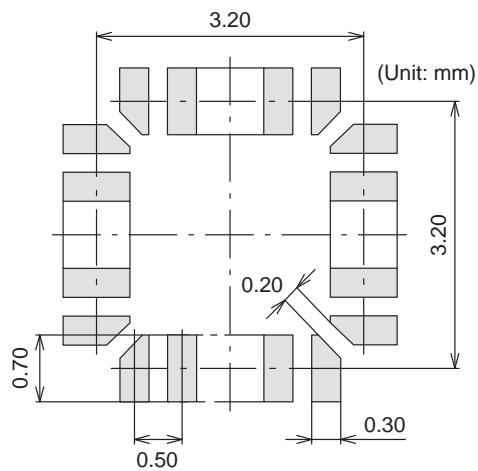
VCT24 3.5x3.5, 0.5P

CASE 601AD

ISSUE A



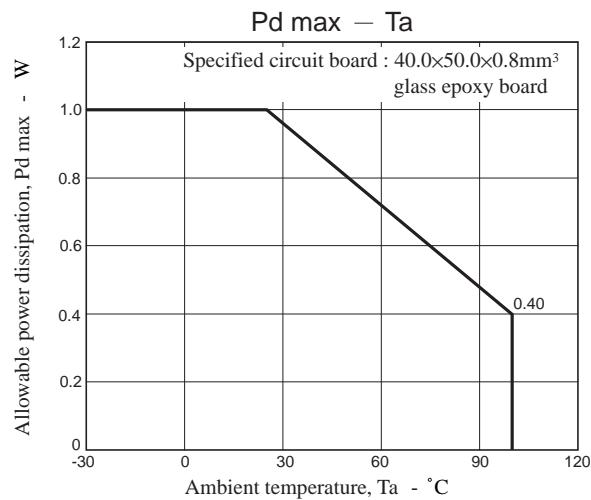
SOLDERING FOOTPRINT*



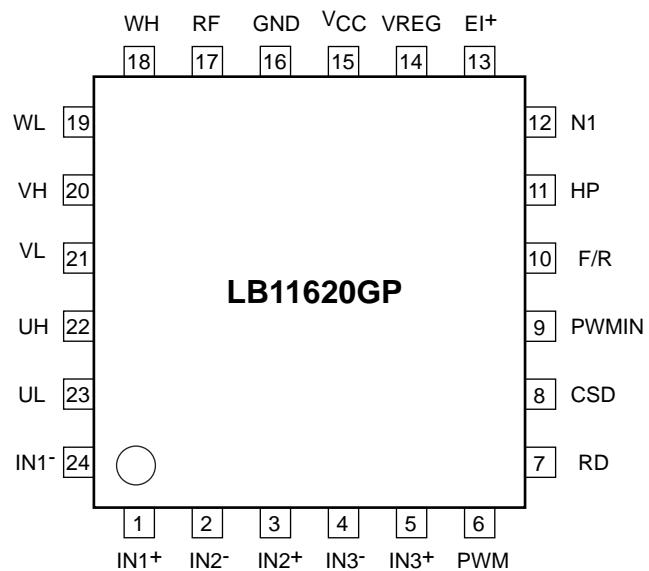
NOTE: The measurements are not to guarantee but for reference only.

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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Pin Assignment



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- Three-Phase Logic Truth Table (IN = "H" indicates the state where $IN^+ > IN^-$)

	F/R = "L"			F/R = "H"			Output	
	IN1	IN2	IN3	IN1	IN2	IN3	PWM	
1	H	L	H	L	H	L	VH	UL
2	H	L	L	L	H	H	WH	UL
3	H	H	L	L	L	H	WH	VL
4	L	H	L	H	L	H	UH	VL
5	L	H	H	H	L	L	UH	WL
6	L	L	H	H	H	L	VH	WL

- PWMIN pin

Input state	State
High or open	Output off
Low	Output on

If the PWM pin is not used, the input must be held at the low level.

- N1 pin

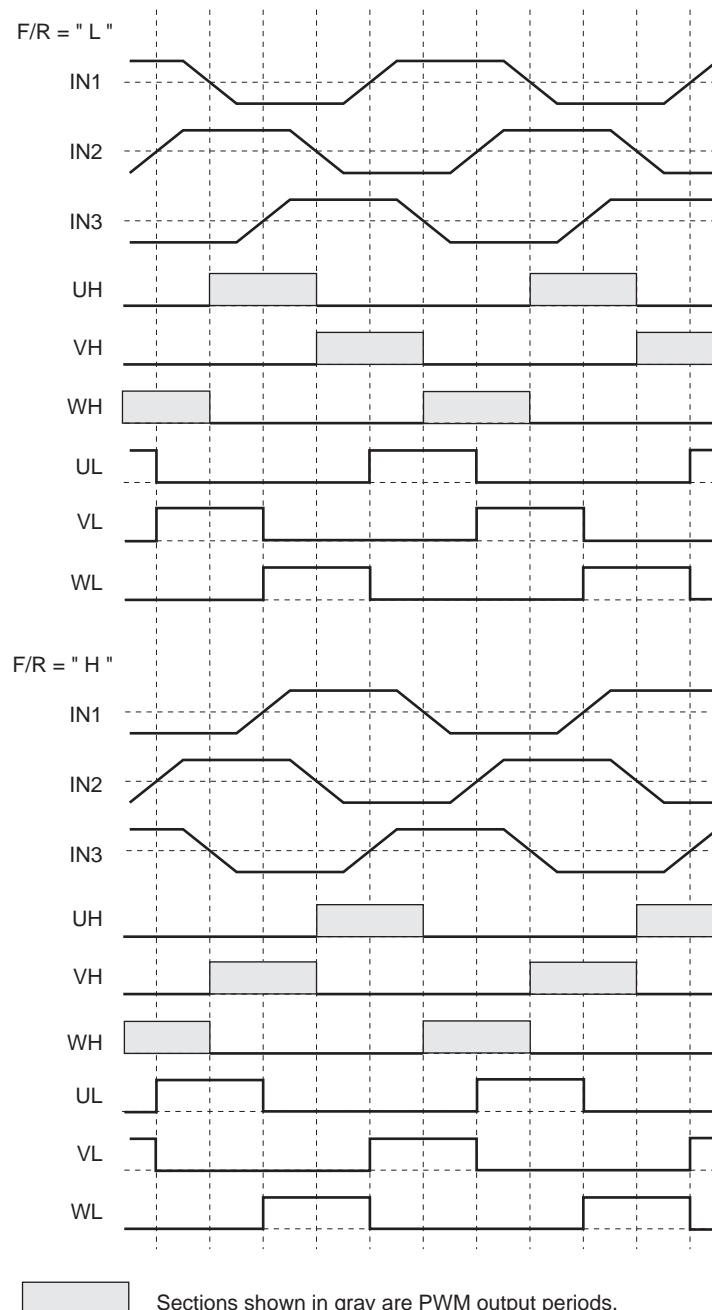
Input state	HP output
High or open	Three Hall sensor synthesized output
Low	Single Hall sensor output

Explanation of Pin Functions

Pin No.	Pin	Description
1, 24	IN1 ⁺ , IN1 ⁻	Hall sensor inputs from each motor phase.
3, 2	IN2 ⁺ , IN2 ⁻	The logic high state indicates that $IN^+ > IN^-$.
5, 4	IN3 ⁺ , IN3 ⁻	If inputs are provided by a Hall effect sensor IC, the common-mode input range is expanded by biasing either the + or - input.
6	PWM	Functions as both the PWM oscillator frequency setting pin and the initial reset pulse setting pin. Connect a capacitor between this pin and ground.
7	RD	Lock (motor constrained) detection state output. This output is turned on when the motor is turning and off when the lock protection function detects that the motor has been stopped. This is an open collector output.
8	CSD	Sets the operating time for the lock protection circuit. Connect a capacitor between this pin and ground. Connect this pin to ground if the lock protection function is not used.
9	PWMIN	PWM pulse signal input. The output goes to the drive state when this pin is low and to the off state when this pin is high or open. To use this pin for control, a CTL amplifier input such that the TOC pin voltage goes to the 100% duty state must be provided.
10	F/R	Forward/reverse control input
11	HP	Hall signal output (HP output). This provides either a single Hall sensor output or a synthesized 3-sensor output.
12	N1	Hall signal output (HP output) selection
13	EI+	CTL amplifier + (no inverting) input. The PWMIN pin must be held at the low level to use this input for motor control
14	VREG	5V regulator output (Used as the control circuit power supply. A low-voltage protection circuit is built in.) Connect a capacitor between this pin and ground for stabilization.
15	V _{CC}	Power supply. Connect a capacitor between this pin and ground to prevent noise and other disturbances from affecting this IC.
16	GND	Ground
17	RF	Output current detection. The current detection resistor (R _f) voltage is sensed by the RF pin to implement current detection. The maximum output current is set by RF to be $I_{OUT} = 0.25/R_f$.
22	UH	Outputs (PWM outputs).
20	VH	These are push-pull outputs.
18	WH	
23	UL	Outputs
21	VL	These are push-pull outputs.
19	WL	

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Hall Sensor Signal Input/Output Timing Chart

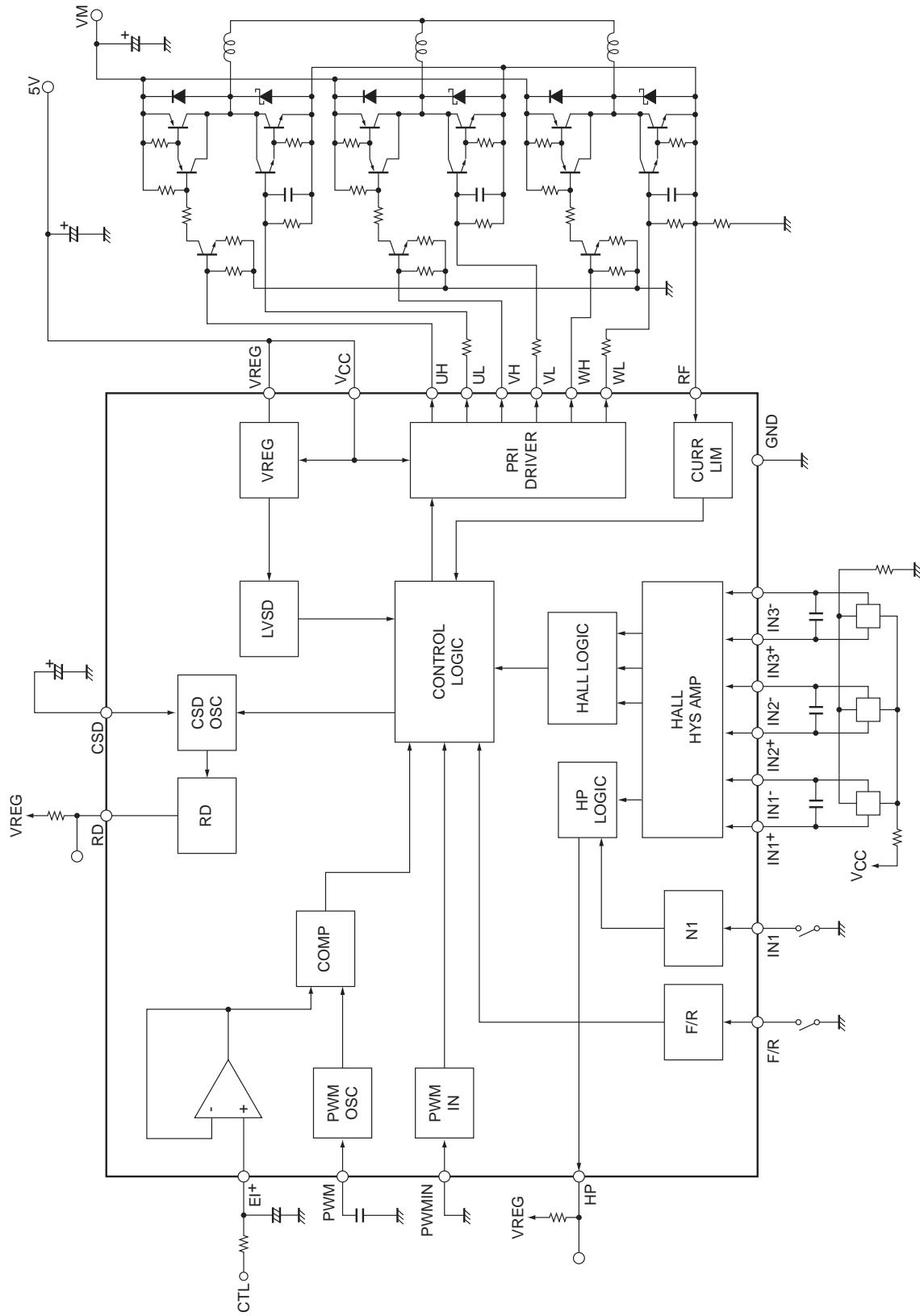


Sections shown in gray are PWM output periods.

Block Diagram and Application Example 1

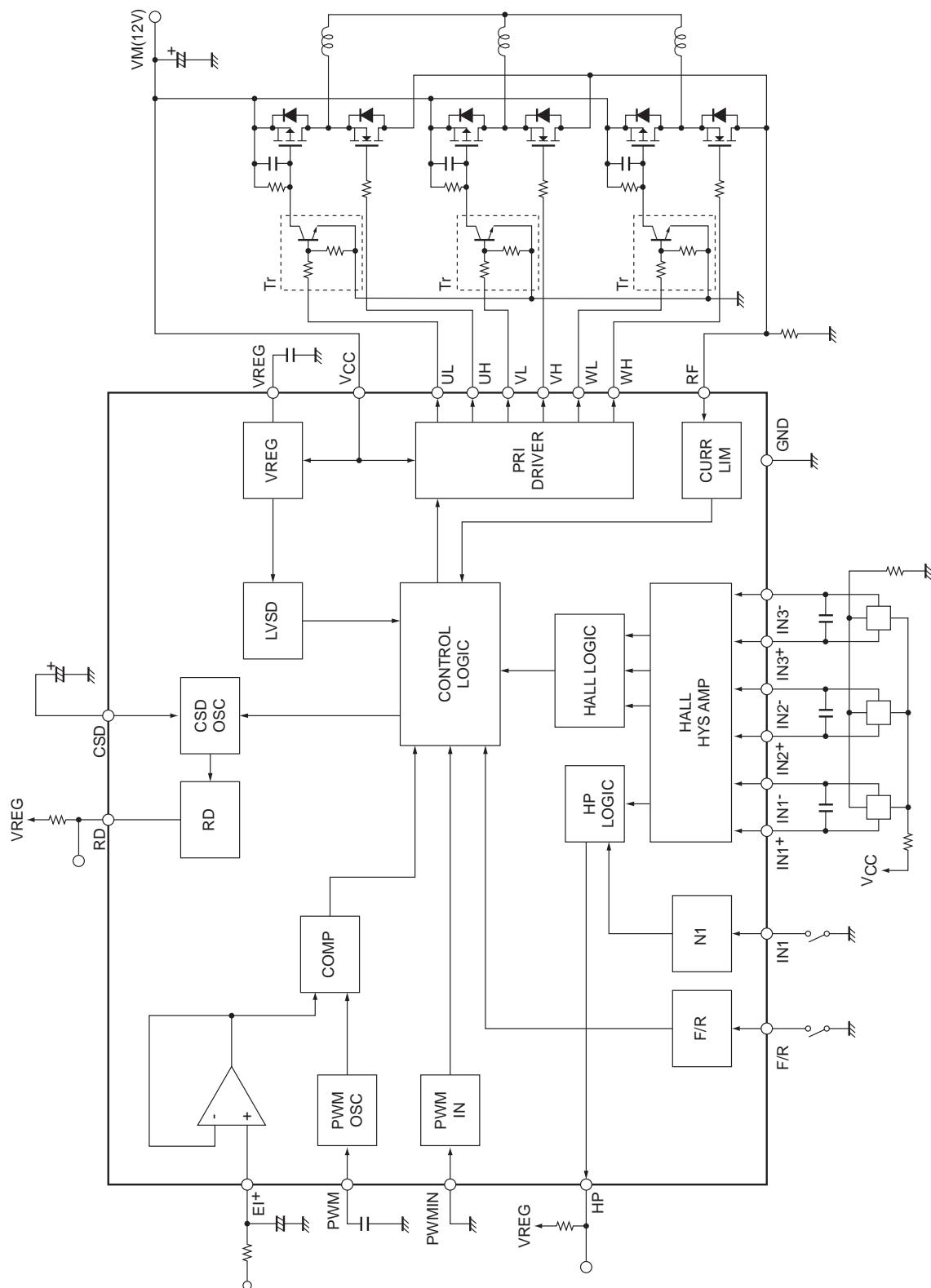
Bipolar transistor drive (high side PWM)

Using a 5V power supply



Application Example 2

54 MOS transistor drive (low side PWM)
Using a 12V single-voltage power supply

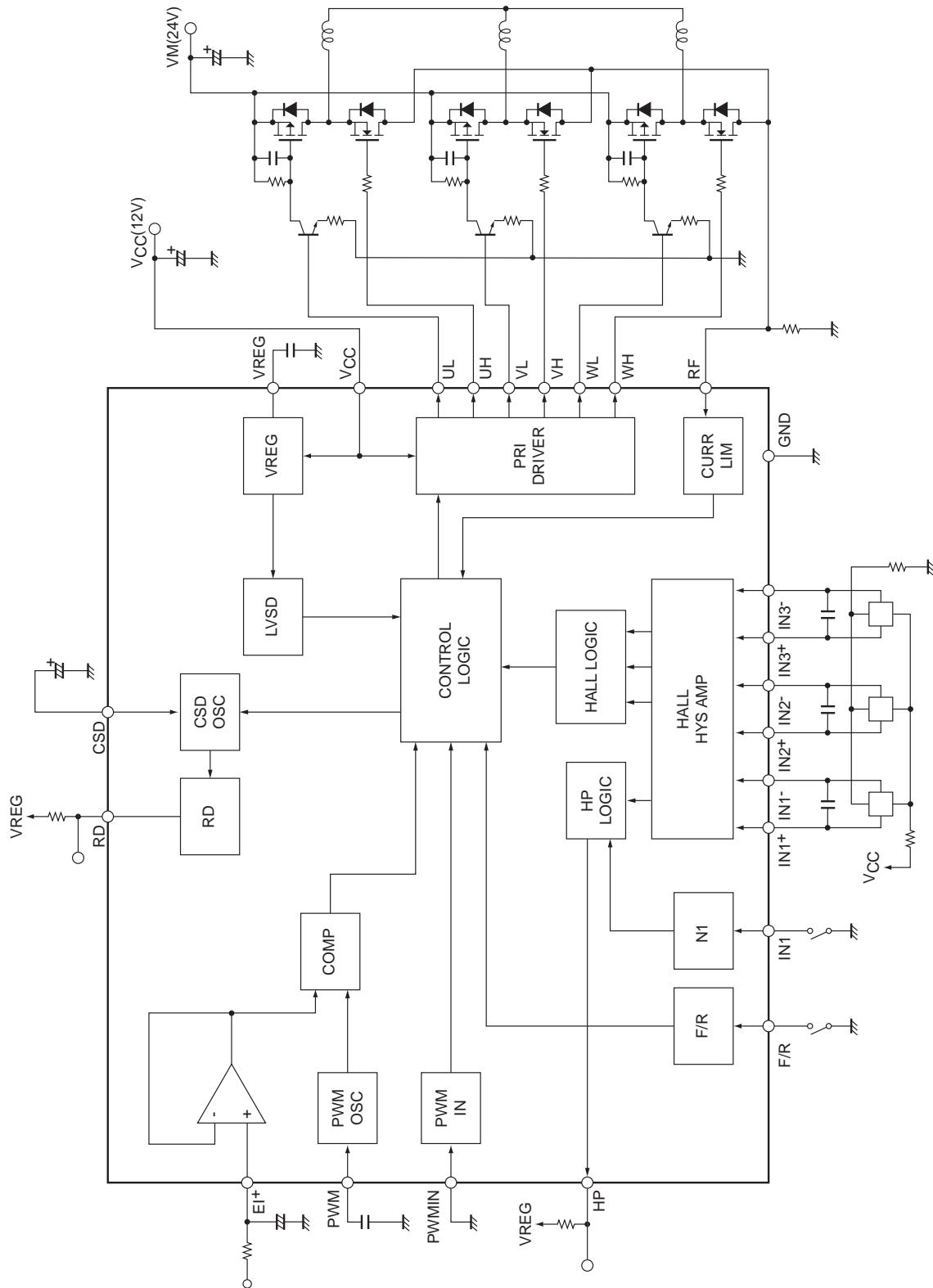


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Application Example 3

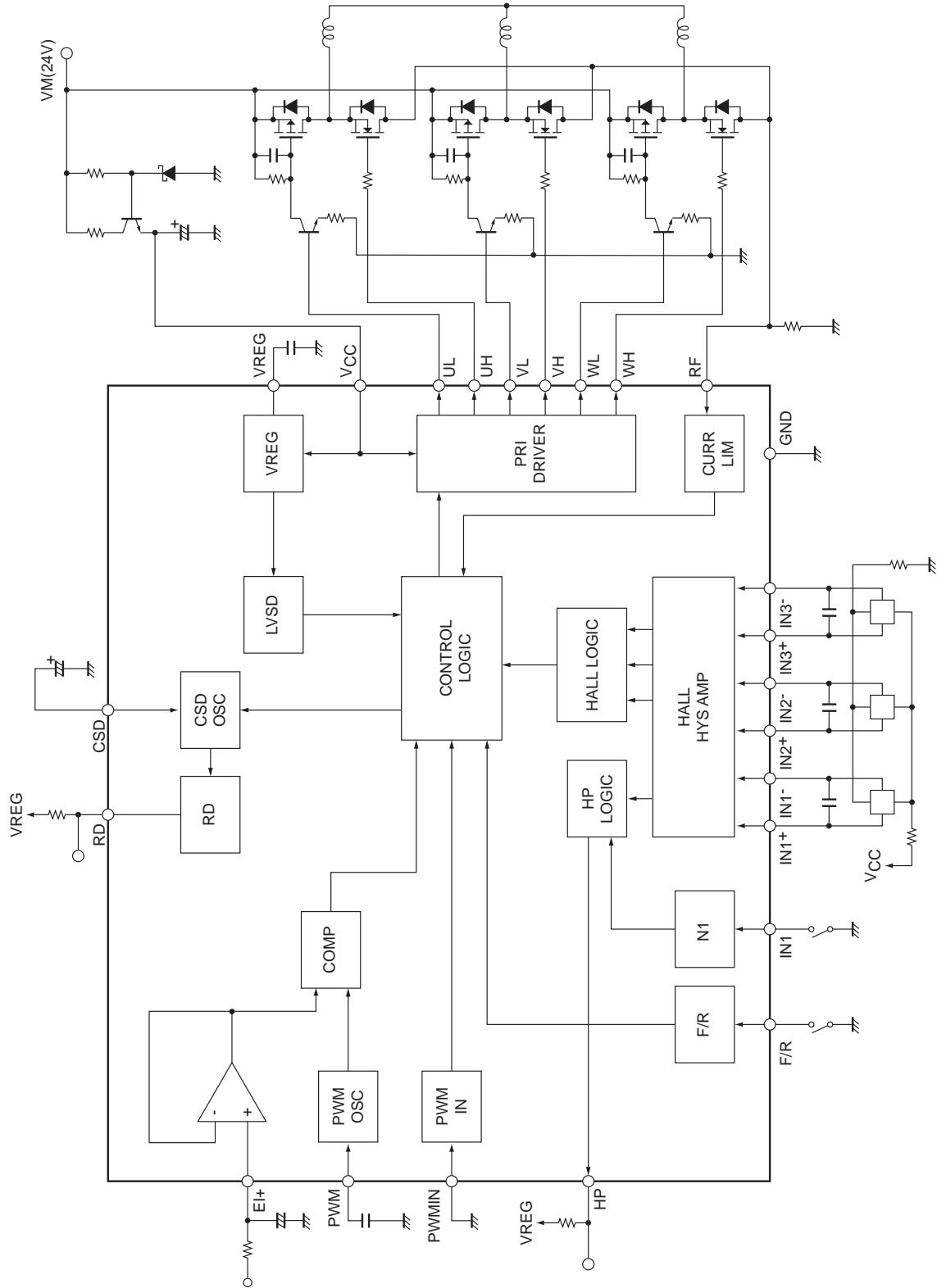
MOS transistor drive (low side PWM)

Using a $V_{CC} = 12V$, $VM = 24V$ power supply system



Application Example 4

MOS transistor drive (low side PWM)
Using a 24V single-voltage power supply



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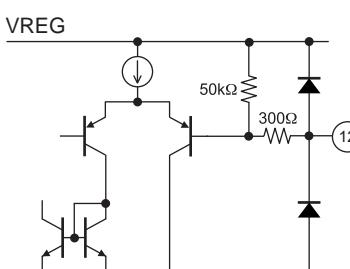
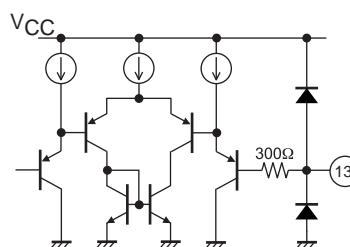
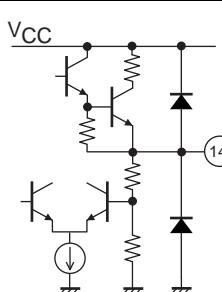
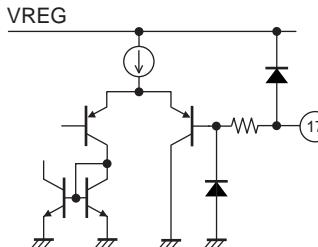
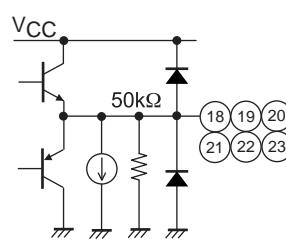
Pin Functions

PIN No.	PIN name	Function	Equivalent circuit
24 1 2 3 4 5	IN1- IN1+ IN2- IN2+ IN3- IN3+	Hall input pin. IN+ > IN- to "H", IN+ < IN- to "L". Connect the capacitor between IN+ and IN- when the noise of the hall signal becomes a problem.	
6	PWM	Functions as both the PWM oscillator frequency setting pin and the initial reset pulse setting pin. Connect a capacitor between this pin and ground. It is possible to set it to about 22kHz with C=2000pF.	
7	RD	Lock (motor constrained) detection state output. This output is turned on when the motor is turning and off when the lock protection function detects that the motor has been stopped.	
11	HP	Hall signal output pin. Two kinds of outputs can be selected by setting the N1 pin.	
8	CSD	Sets the operating time for the lock protection circuit. Connect a capacitor between this pin and ground. Connect this pin to ground if the lock protection function is not used.	
9	PWMIN	PWM pulse signal input. The output goes to the drive state when this pin is low and to the off state when this pin is high or open. To use this pin for control, a CTL amplifier input such that the TOC pin voltage goes to the 100% duty state must be provided.	
10	F/R	Forward/reverse control input.	

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PIN No.	PIN name	Function	Equivalent circuit
10	F/R	Forward/reverse control input.	
12	N1	Hall signal output (HP output) selection.	
13	El+	CTL amplifier + (no inverting) input. The PWMIN pin must be held at the low level to use this input for motor control.	
14	VREG	Stabilizing supply output pin. (5V output) Connect a capacitor between this pin and ground for stabilization. (about 0.1μF level)	
15	VCC	Power supply. Connect a capacitor between this pin and ground to prevent noise and other disturbances from affecting this IC.	
16	GND	Ground	
17	RF	Output current sensing pin. The low resistance is connected between RF and GND. It sets it by output maximum current $I_{OUT}=0.25/R_f$.	
18 19 20 21 22 23	WH WL VH VL UH UL	Output pin. (Driving external TR output) The duty is controlled on UH, VH, and WH side.	

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