



LB11995

Three-Phase Brushless Motor Driver for CD-ROM Spindle Drive

Overview

The LB11995 is a 3-phase brushless motor driver especially suited for CD-ROM spindle motor drives.

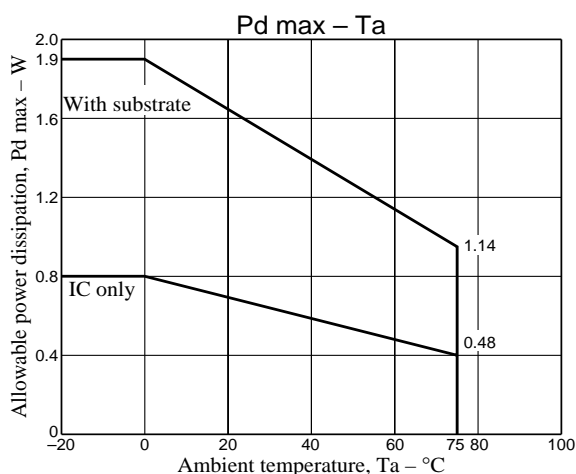
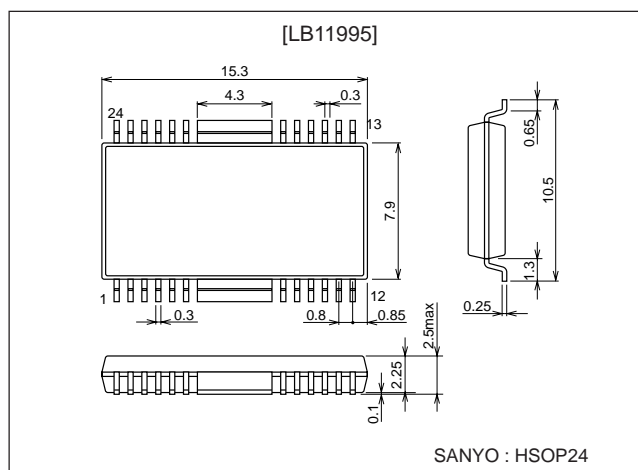
Functions

- Current linear drive
- Control V type amplifier
- Separate power supply for output upper side bias circuit allows low output saturation by boosting this power supply only (useful for 5V power supply types).
- Upper side current detection technique reduces loss voltage of current detection resistor. Voltage drop caused by this resistor reduces internal power dissipation of IC.
- Built-in short braking circuit
- Built-in reverse blocking circuit
- Hall FG output
- Built-in S/S function
- Built-in current limiter circuit (selectable, 2 steps)
- Built-in Hall power supply
- Built-in thermal shutdown circuit
- Supports 3.3V DSP

Package Dimensions

unit: mm

3227-HSOP24



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Specifications

Maximum Ratings at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|---------------|---|-------------|------|
| Power supply voltage | V_{CC1} max | | 7.0 | V |
| | V_{CC2} max | | 14.4 | V |
| | V_{CC3} max | | 14.4 | V |
| Applied output voltage | V_O max | | 14.4 | V |
| Applied input voltage | V_{IN} max | | V_{CC1} | V |
| Output current | I_O max | | 1.3 | A |
| Allowable power dissipation | Pd max | IC only | 0.8 | W |
| | | with substrate (114.3 x 76.1 x 1.6 mm ³ , glass epoxy) | 1.9 | W |
| Operating temperature | Topr | | -20 to +75 | °C |
| Storage temperature | Tstg | | -55 to +150 | °C |

Operating Conditions at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|----------------------|-----------|----------------|-----------|------|
| Power supply voltage | V_{CC1} | | 4 to 6 | V |
| | V_{CC2} | $\geq V_{CC1}$ | 4 to 13.6 | V |
| | V_{CC3} | | 4 to 13.6 | V |

Sample Application at $T_a = 25^\circ\text{C}$

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------|---------------------|--|-----------|------|
| 12V type | V_{CC1} | Regulated voltage | 4 to 6 | V |
| | $V_{CC2} = V_{CC3}$ | Unregulated voltage | 4 to 13.6 | V |
| 5V type | $V_{CC1} = V_{CC3}$ | Regulated voltage | 4 to 6 | V |
| | V_{CC2} | Boost-up voltage or regulated voltage (Note) | 4 to 13.6 | V |

Note: When boost-up voltage is used at V_{CC2} , output can be set to low-saturation.

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Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = V_{CC3} = 12\text{V}$

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|--|------------------|---|---------|------|---------------|-------------------|
| | | | min | typ | max | |
| [Power supply current] | | | | | | |
| Power supply current | I_{CC1} | $V_C = V_{CREF}$ | | 8 | | mA |
| | I_{CC2} | $V_C = V_{CREF}$ | | 0 | | mA |
| | I_{CC3} | $V_C = V_{CREF}$ | | 150 | 250 | μA |
| Output idle current | I_{CC1OQ} | $V_{S/S} = 0\text{V}$ | | | 200 | μA |
| | I_{CC2OQ} | $V_{S/S} = 0\text{V}$ | | | 30 | μA |
| | I_{CC3OQ} | $V_{S/S} = 0\text{V}$ | | | 30 | μA |
| [Output] | | | | | | |
| Saturation voltage, upper side 1 lower side 1 | V_{OU1} | $I_O = -0.5\text{A}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = V_{CC3} = 12\text{V}$ | | 1.0 | | V |
| | V_{OD1} | $I_O = 0.5\text{A}$, $V_{CC1} = 5\text{V}$, $V_{CC2} = V_{CC3} = 12\text{V}$ | | 0.3 | | V |
| Saturation voltage, upper side 2 lower side 2 | V_{OU2} | $I_O = -0.5\text{A}$, $V_{CC1} = V_{CC3} = 5\text{V}$, $V_{CC2} = 12\text{V}$ | | 0.3 | | V |
| | V_{OD2} | $I_O = 0.5\text{A}$, $V_{CC1} = V_{CC3} = 5\text{V}$, $V_{CC2} = 12\text{V}$ | | 0.3 | | V |
| Current limiter setting voltage | V_{CL1} | $R_{RF} = 0.33\Omega$, LMC; OPEN | | 0.24 | | V |
| | V_{CL2} | $R_{RF} = 0.33\Omega$, LMC; GND | | 0.35 | | V |
| [Hall amplifier] | | | | | | |
| Common mode input voltage range | V_{HCOM} | | 1.2 | | $V_{CC1}-1.0$ | V |
| Input bias current | I_{HIB} | | | 1 | | μA |
| Minimum Hall input level | V_{HIN} | | 60 | | | mV _{P-P} |
| [S/S pin] | | | | | | |
| High level voltage | $V_{S/SH}$ | | 2.0 | | V_{CC1} | V |
| Low level voltage | $V_{S/SL}$ | | | | 0.7 | V |
| Input current | $I_{S/SI}$ | $V_{S/S} = 5\text{V}$ | | | 200 | μA |
| Leak current | $I_{S/SL}$ | $V_{S/S} = 0\text{V}$ | -30 | | | μA |
| [Control] | | | | | | |
| V_C pin input current | I_{VC} | $V_C = V_{CREF} = 1.65\text{V}$ | | | 1 | μA |
| V_{CREF} pin input current | I_{VCREF} | $V_C = V_{CREF} = 1.65\text{V}$ | | | 1 | μA |
| Voltage gain | GV_{CO} | $\Delta V_{RF}/\Delta V_C$ | | 0.35 | | times |
| Startup voltage | V_{CTH} | $V_{CREF} = 1.65\text{V}$ | 1.5 | | 1.8 | V |
| Startup voltage width | ΔV_{CTH} | $V_{CREF} = 1.65\text{V}$ | 50 | | 150 | mV |
| [Hall power supply] | | | | | | |
| Hall power supply voltage | V_H | $I_H = 5\text{mA}$ | | 0.8 | | V |
| Allowable current | I_H | | 20 | | | mA |
| [Thermal shutdown] | | | | | | |
| Operating temperature | T_{TSD} | Design target value | 150 | 180 | 210 | $^\circ\text{C}$ |
| Hysteresis | ΔT_{TSD} | Design target value | | 15 | | $^\circ\text{C}$ |
| [Short braking] | | | | | | |
| Brake pin at High level | V_{BRH} | | 4 | | 5 | V |
| Brake pin at Low level | V_{BRL} | | 0 | | 1 | V |

Note:

- During S/S OFF (standby), the Hall comparator is at High.
- Items shown to be design target values are not measured.

Truth Table

| | Source → Sink | Hall input | | | Control |
|---|-------------------|------------|---|---|----------------|
| | | U | V | W | V _C |
| 1 | Phase W → Phase V | H | H | L | H |
| | Phase V → Phase W | | | | L |
| 2 | Phase W → Phase U | H | L | L | H |
| | Phase U → Phase W | | | | L |
| 3 | Phase V → Phase W | L | L | H | H |
| | Phase W → Phase V | | | | L |
| 4 | Phase U → Phase V | L | H | L | H |
| | Phase V → Phase U | | | | L |
| 5 | Phase V → Phase U | H | L | H | H |
| | Phase U → Phase V | | | | L |
| 6 | Phase U → Phase W | L | H | H | H |
| | Phase W → Phase U | | | | L |

Input:

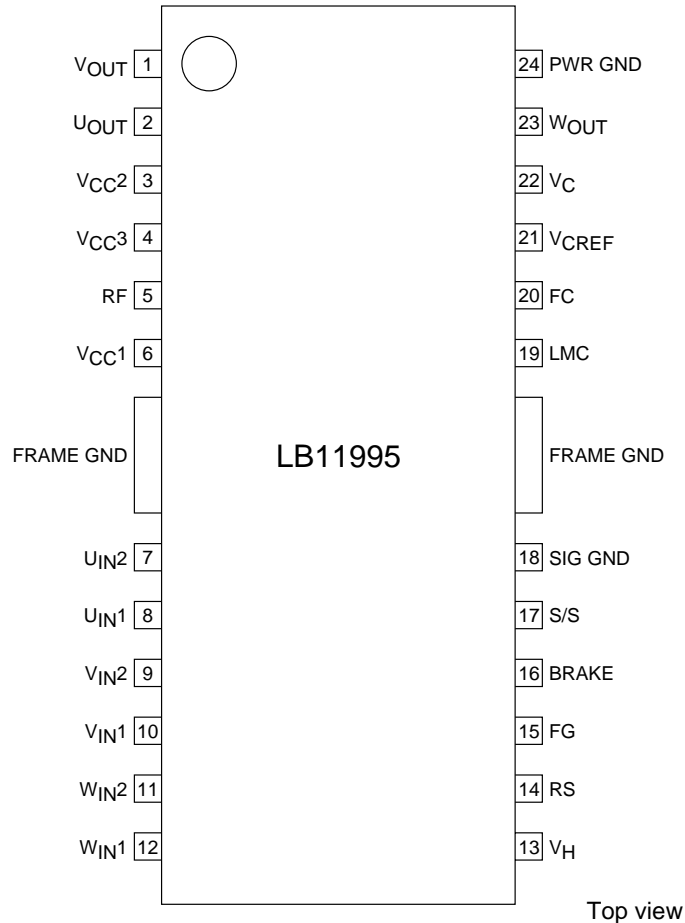
H: Input 1 is higher in potential than input 2 by at least 0.2V.

L: Input 1 is lower in potential than input 2 by at least 0.2V.

Brake Operation Truth Table

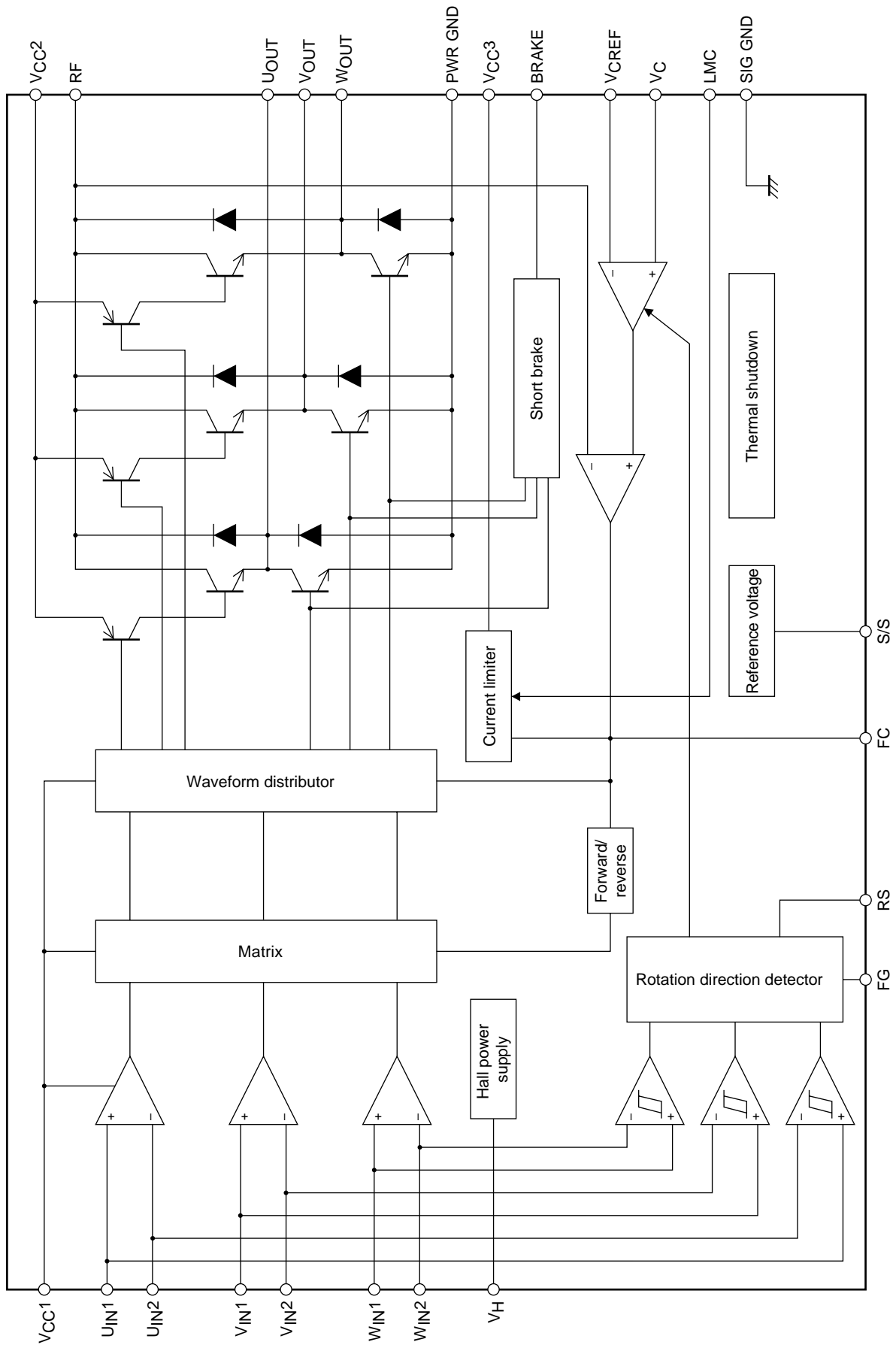
| BRAKE pin | Operation |
|-------------|-----------------|
| H | Short brake |
| Low or open | Normal rotation |

Pin Assignment



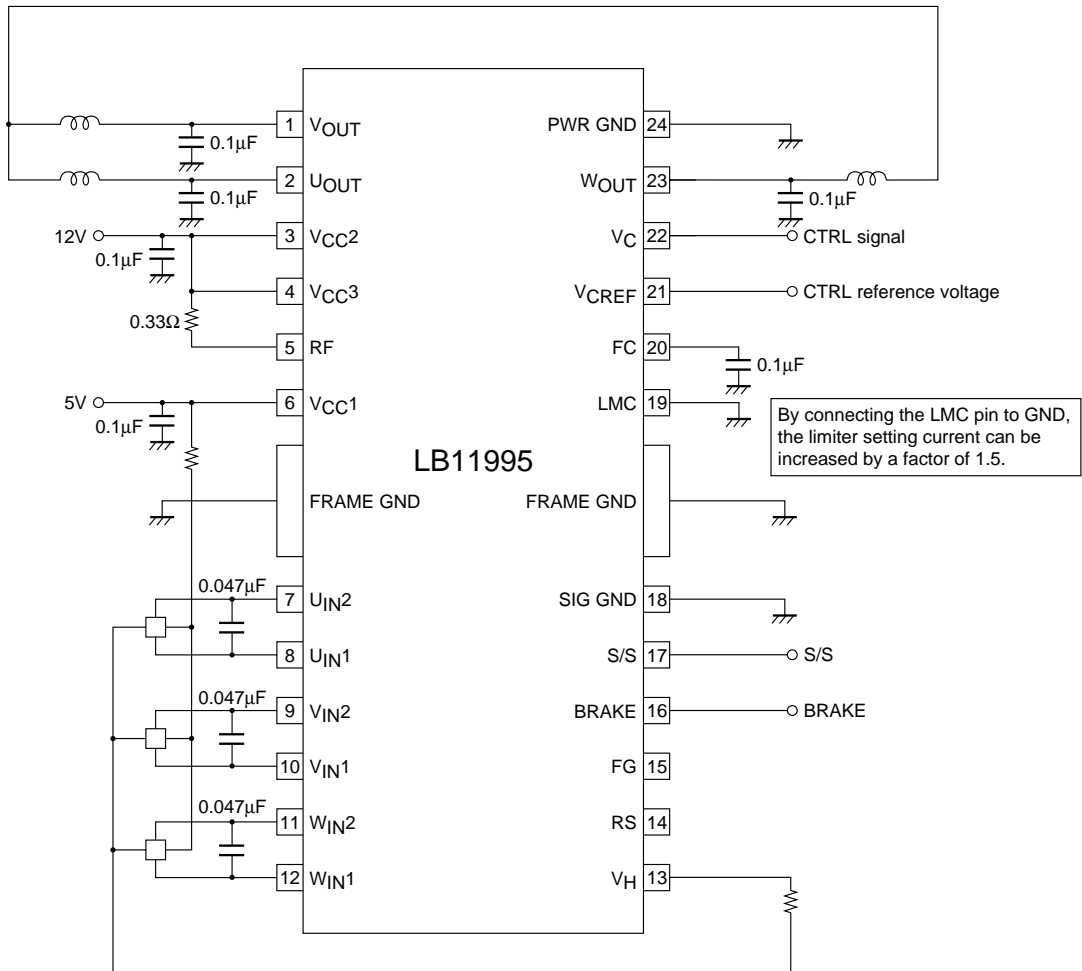
Top view

Block Diagram



A12338

Sample Application Circuit 1 (12V Version)

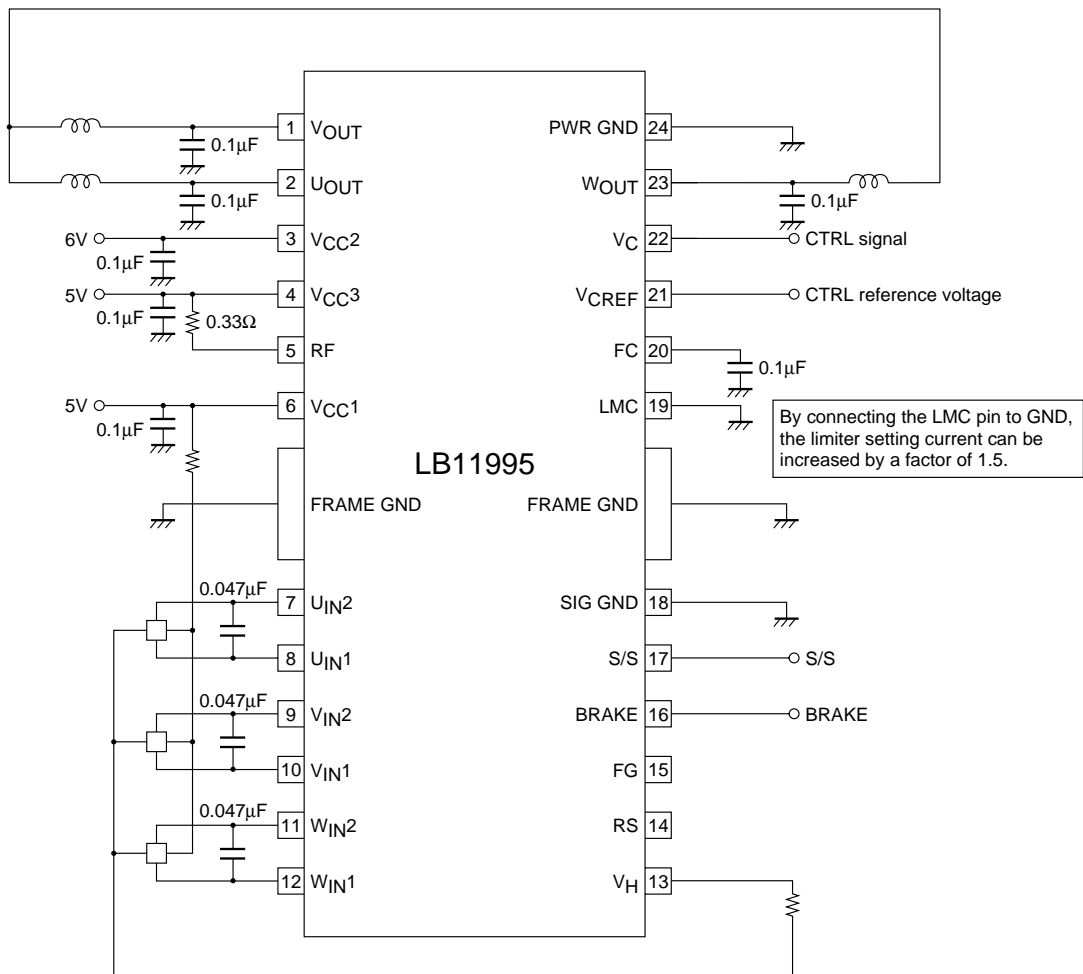


A12339

Power supply - GND
 Output - GND
 Between Hall inputs

Capacitor requirements may change depending on motor.
 For some motors, capacitor between Hall inputs may not be needed.

Sample Application Circuit 2 (5V Version)

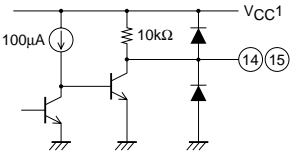
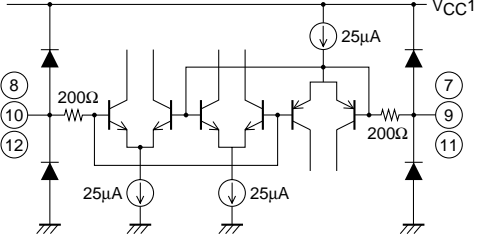
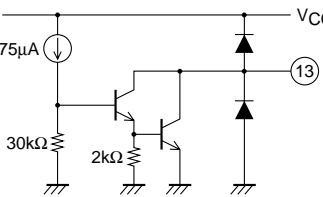
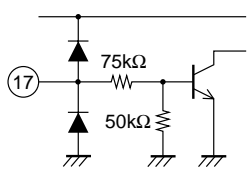
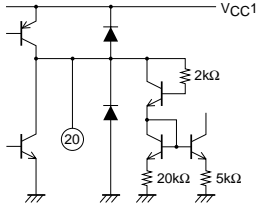


A12340

Power supply - GND
Output - GND
Between Hall inputs

Capacitor requirements may change depending on motor.
For some motors, capacitor between Hall inputs may not be needed.

Pin Descriptions

| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|------------|--------------------------------------|------------------------------|--|---|
| 3 | V _{CC2} | 4V to 13.6V | | Source side predrive voltage supply pin |
| 4 | V _{CC3} | 4V to 13.6V | | Constant current control amplifier voltage supply pin |
| 6 | V _{CC1} | 4V to 6V | | Power supply pin for all circuits except output transistors, source predriver, and constant current control amplifier |
| 14 | RS | |  <p style="text-align: right;">A12341</p> | Reverse detector pin Forward rotation: High Reverse rotation: Low |
| 15 | FG | | | 1 Hall element waveform Schmitt comparator composite output |
| 8 7 | U _{IN1} U _{IN2} | 1.2V to V _{CC1} -1V |  <p style="text-align: right;">A12342</p> | U phase Hall element input and reverse detector U phase Schmitt comparator input pin Logic High indicates U _{IN1} > U _{IN2} . |
| 10 9 | V _{IN1} V _{IN2} | | | V phase Hall element input and reverse detector V phase Schmitt comparator input pin Logic High indicates V _{IN1} > V _{IN2} . |
| 12 11 | W _{IN1} W _{IN2} | | | W phase Hall element input and reverse detector W phase Schmitt comparator input pin Logic High indicates W _{IN1} > W _{IN2} . |
| 13 | V _H | |  <p style="text-align: right;">A12343</p> | Hall element lower side bias voltage supply pin |
| 17 | S/S | 0V to V _{CC1} |  <p style="text-align: right;">A12344</p> | When this pin is at 0.7V or lower, or when it is open, all circuits are inactive. When driving motor, set this pin to 2V or higher. |
| 18 | SIG GND | | | GND pin for all circuits except output |
| 20 | FC | |  <p style="text-align: right;">A12345</p> | Control loop frequency compensator pin. Connecting a capacitor between this pin and GND prevents closed loop oscillation in current limiting circuitry. |

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| Pin number | Pin name | Pin voltage | Equivalent circuit | Pin function |
|------------|-------------------|---------------------------------|--|--|
| 21 | V _{CREF} | 0V to V _{CC1} -1.5V | <p style="text-align: right; font-size: small;">A12346</p> | Control reference voltage supply pin. Determines control start voltage. |
| 22 | V _C | 0V to V _{CC1} | | Speed control voltage supply pin V type control technique V _C > V _{CREF} : Forward V _C < V _{CREF} : Slowdown (Reverse-blocking circuit prevents reverse rotation.) |
| 23 | W _{OUT} | | <p style="text-align: right; font-size: small;">A12347</p> | W phase output |
| 24 | PWR GND | | | Output transistor GND |
| 1 | V _{OUT} | | | V phase output |
| 2 | U _{OUT} | | | U phase output |
| 5 | RF | | | Upper side output NPN transistor collector pin (common for all 3 phases). For current detection, connect resistor between V _{CC3} pin and RF pin. Constant current control and current limiter works by detecting this voltage. |
| 19 | LMC | | <p style="text-align: right; font-size: small;">A12348</p> | When this pin is connected to GND, the limiter setting current is increased by a factor of 1.5. |
| 16 | BRAKE | | <p style="text-align: right; font-size: small;">A12349</p> | Short brake pin BRAKE: High → Short brake operation Low/Open → Motor drive operation |

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