## Specifications

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

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| $V_{CC}$ maximum supply voltage | $V_{CC}$ max | | 20 | V |
| VM maximum supply voltage | VM max | | 20 | V |
| OUT pin maximum output current | $I_{OUT}$ max | Rf ≥ 0.39Ω | 1.5 | A |
| OUT pin output voltage 1 | $V_{OUT}$ max 1 | | 20 | V |
| OUT pin output voltage 2 | $V_{OUT}$ max 2 | T ≤ 0.4μs | 26.5 | V |
| PRE pin maximum source current | IPSO max | | 30 | mA |
| PRE pin maximum sink current | IPSI max | | −7 | mA |
| PRE pin output voltage | VP max | | 20 | V |
| HB maximum output current | HB max | | 10 | mA |
| VTH input pin voltage | VTH max | | 7 | V |
| FG output pin voltage | VFG max | | 18 | V |
| FG output current | IFG max | | 10 | mA |
| Allowable power dissipation | Pd max | When mounted on a circuit board *1 | 0.8 | W |
| Operating temperature | Topr | *2 | −30 to +90 | °C |
| Storage temperature | Tstg | | −55 to +150 | °C |

*1 Specified circuit board : 114.3 × 76.1 × 1.6mm$^3$, glass epoxy.

*2: Tj max is 150°C. This device must be used under conditions such that the chip temperature does not exceed Tj = 150°C during operation.

Stresses exceeding those listed in the Maximum Ratings 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.

### Recommended Operating Conditions at Ta = 25°C

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|---|---|---|---|
| $V_{CC}$ supply voltage | $V_{CC}$ | | 4 to 15 | V |
| $V_M$ supply voltage | VM | | 3 to 15 | V |
| Current limiter operation range | ILIM | | 0.6 to 1.2 | V |
| VTH input level voltage range | VTH | | 0 to 6 | V |
| Hall sensor input common-mode input voltage range | VICM | | 0.2 to 3 | V |

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** Unless otherwise specified Ta = 25°C, $V_{CC}$ = 12V

| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---|---|---|---|---|---|---|
| | | | min | typ | max | |
| Circuit current | $I_{CC}1$ | Drive mode | | 9 | 12 | mA |
| HB voltage | VHB | IHB = 5mA | 1.05 | 1.25 | 1.40 | V |
| 6VREG voltage | V6VREG | 6VREG = 5mA | 5.80 | 6 | 6.20 | V |
| CT pin high-level voltage | VCTH | | 3.4 | 3.6 | 3.8 | V |
| CT pin low-level voltage | VCTL | | 1.4 | 1.6 | 1.8 | V |
| ICT pin charge current 1 | ICTC1 | $V_{CC}$ = 12V | 1.7 | 2.2 | 2.7 | μA |
| ICT pin charge current 2 | ICTC2 | $V_{CC}$ = 6V | 1.3 | 1.8 | 2.3 | μA |
| ICT pin discharge current 1 | ICTD1 | $V_{CC}$ = 12V | 0.11 | 0.15 | 0.19 | μA |
| ICT pin discharge current 2 | ICTD2 | $V_{CC}$ = 6V | 0.34 | 0.44 | 0.54 | μA |
| ICT charge/discharge current ratio 1 | RCT1 | $V_{CC}$ = 12V | 12 | 15 | 18 | Times |
| ICT charge/discharge current ratio 2 | RCT2 | $V_{CC}$ = 6V | 3 | 4 | 5 | Times |
| ICT charge/discharge ratio threshold voltage | VRCT | | 6 | 6.6 | 7.3 | V |
| VTH bias current | IBVTH | | −2 | −1 | 0 | μA |
| OUT output high saturation voltage | $V_{OH}$ | $I_O$ = 200mA, RL = 1Ω | | 0.6 | 0.8 | V |
| PRE output low saturation voltage | $V_{PL}$ | $I_O$ = 5mA | | 0.2 | 0.4 | V |
| PRE output high saturation voltage | $V_{PH}$ | $I_O$ = −20mA | | 0.9 | 1.2 | V |
| Current limiter | VRf | $V_{CC}$ − VM | 450 | 500 | 550 | mV |
| PWM output pin high-level voltage | VPWMH | | 2.2 | 2.5 | 2.8 | V |
| PWM output pin low-level voltage | VPWML | | 0.4 | 0.5 | 0.7 | V |
| PWM external C charge current | IPWM1 | | −23 | −18 | −14 | μA |
| PWM external C discharge current | IPWM2 | | 18 | 24 | 30 | μA |
| PWM oscillator frequency | FPWM | C = 200pF | 19 | 23 | 27 | kHz |
| Hall sensor input sensitivity | VHN | Zero peak value (including offset and hysteresis) | | 15 | 25 | mV |
| FG output pin low-level voltage | VFG/RD | IFG/RD = 5mA | | 0.2 | 0.3 | V |
| FG output pin leakage current | IFGL/IRDL | VFG/RD = 7V | | | 30 | μA |
| Thermal protection circuit | THD | Design target value*3 | 150 | 180 | 210 | °C |

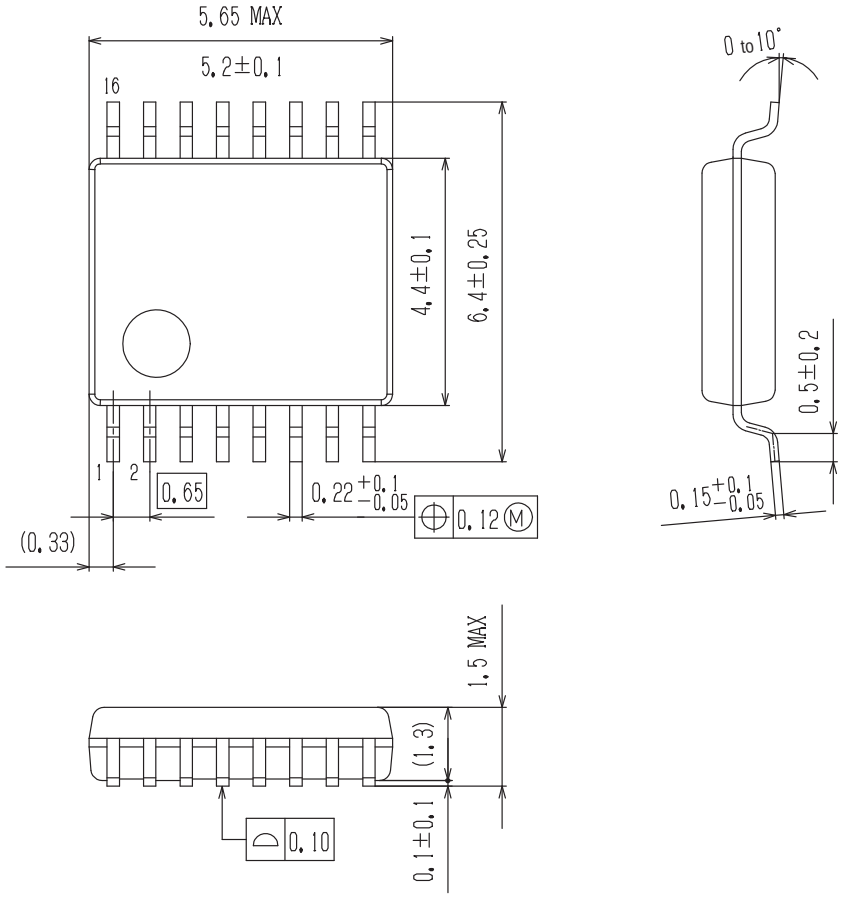
*3: This is a design guarantee and is not tested in individual units. The thermal protection circuit is included to prevent any thermal damage to the IC. Since this would imply operation outside the IC's guaranteed temperature range, the application thermal design must be such that the thermal protection circuit will not operate if the fan is operating constantly.

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.

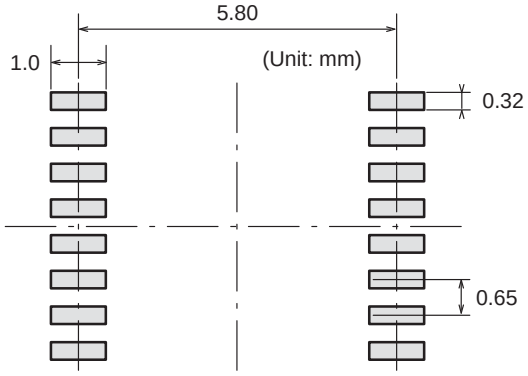
## Package Dimensions

unit : mm

**SSOP16 (225mil)**
CASE 565AM
ISSUE A



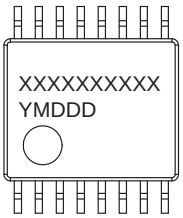

### SOLDERING FOOTPRINT*




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.

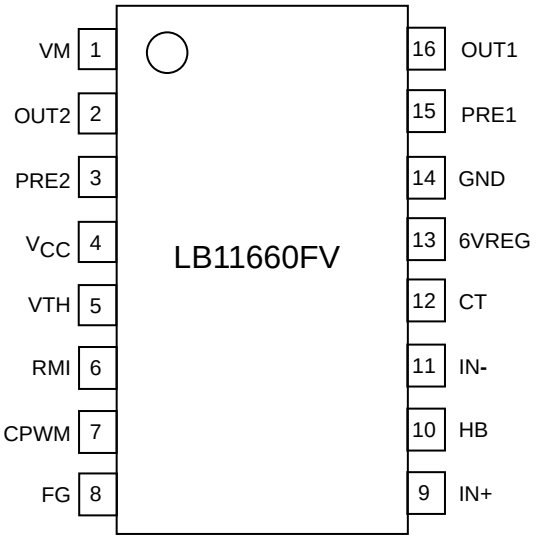
### GENERIC MARKING DIAGRAM*




XXXXX = 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.

## Pin Assignment



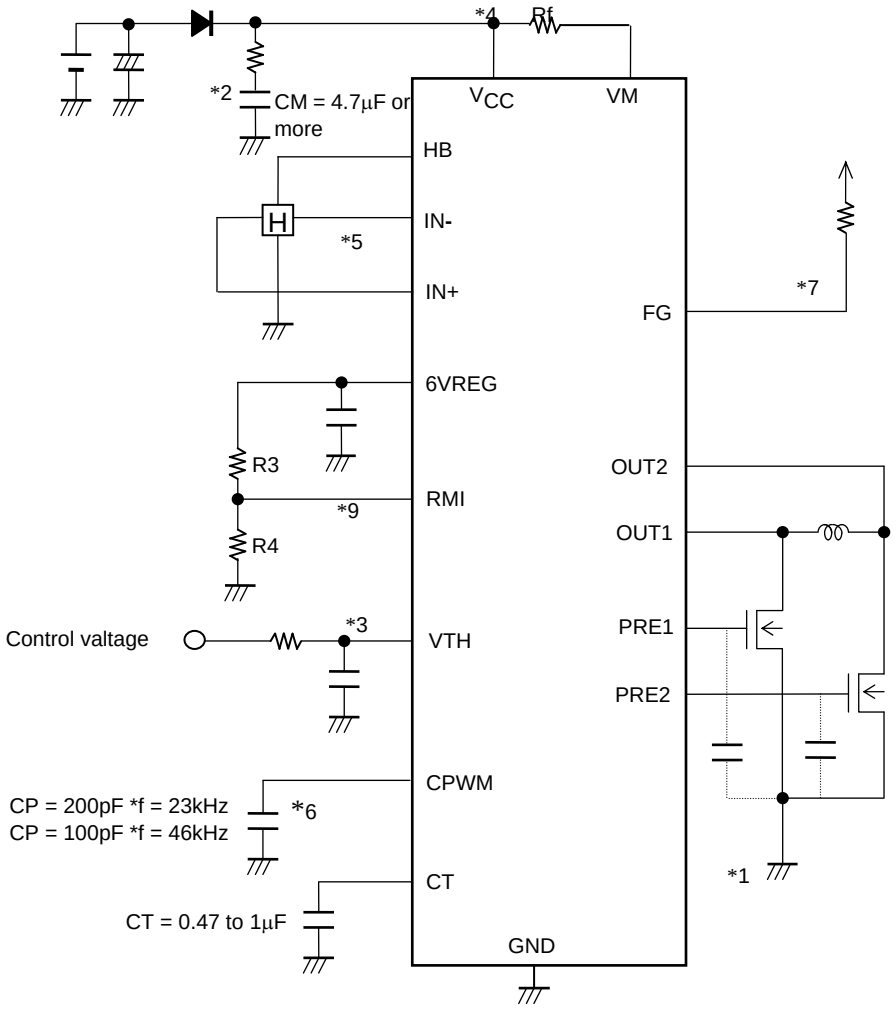

Top view

## Truth Table

| IN- | IN+ | VTH | CPWM | CT | OUT1 | OUT2 | PRE1 | PRE2 | FG | Mode |
|---|---|---|---|---|---|---|---|---|---|---|
| High | Low | Low | High | Low | High | Off | Low | High | Low | During rotation – drive |
| Low | High | | | | Off | High | High | Low | Off | |
| High | Low | High | Low | | Off | Off | Low | High | Low | During rotation – regeneration |
| Low | High | | | | Off | Off | High | Low | Off | |
| High | Low | - | - | High | Off | Off | Low | High | Low | Lock protection |
| Low | High | | | | Off | Off | High | Low | Off | |

CPWM – High is the state where CPWM > VTH, and CPWM– Low is the state where CPWM < VTH.

## Application Circuit Example 1




*1. **Power supply and ground lines**

The IC ground is the control current power supply system ground, and the external n-channel transistor ground is the motor power supply system ground.

These two systems should be formed from separate lines and the control system external components should be connected to the IC ground.

*2. **Regeneration power supply stabilization capacitor**

Use a 4.7µF/25V capacitor at least for CM, which is the power supply stabilization capacitor for both PWM drive and kickback absorption.

The capacitor CM must be connected to prevent destruction of the IC when power is applied or removed.

*3. **Speed Control**

(1) Control voltage

The PWM duty is determined by comparing the VTH pin voltage with the PWM oscillator waveform.

When the VTH voltage falls, the on duty increases and when the VTH voltage falls below the PWM output low level, the duty will go to 100%.

(2) Thermistor

For thermistor applications, normally the 6VREG level will be resistor divided and the divided level input to the VTH pin.

The PWM duty is changed by changes in the VTH pin voltage due to changes in temperature.

*4. **Current limiter setting**

The current limiter circuit operates if the voltage across the resistor between $V_{CC}$ and the VM pin exceeds 0.5V.

Since the current limiter circuit applies limitation at a current determined by $I_O$ = VRf/Rf (where VRf = 0.5V (typical), Rf: resistance of the current detection resistor), the current limiter will operate at $I_O$ = 1A when Rf = 0.5Ω.

The resistor RF must be connected in the circuit and it must have a value such that the circuit operates within the recommended current limiter operating range.

*5. **Hall sensor input**

Lines that are as short as possible must be used to prevent noise from entering the system. The Hall sensor input circuit consists of a comparator with hysteresis (20mV). We recommend that the Hall sensor input level be at least three times this hysteresis, i.e. at least 60mVp-p.

*6. **PWM oscillator frequency setting capacitor**

The PWM oscillator oscillates at f = 23kHz when CP is 200pF and at f = 46kHz when CP is 100pF, and this frequency becomes the PWM reference frequency.

Note that the PWM frequency is given approximately by the following equation.

f [kHz] ≈ $(4.6\times10^{6}) \div C$ [pF]

*7. **FG output**

This is an open collector output, and a rotation count detection function can be implemented using this FG output, which corresponds to the phase switching. This pin must be left open if unused.

*8. **HB pin**

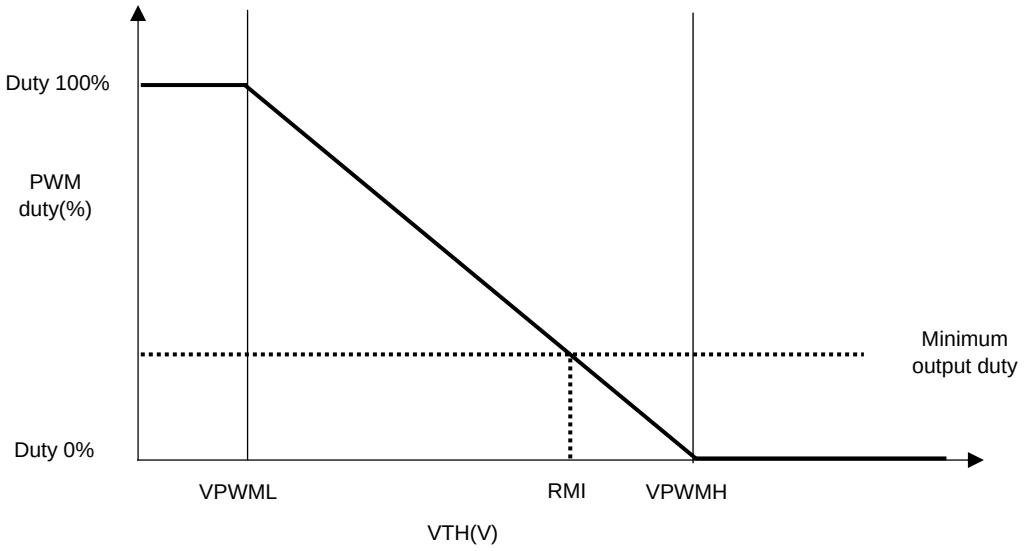
This pin provides a Hall effect sensor bias constant-voltage output of 1.25V.

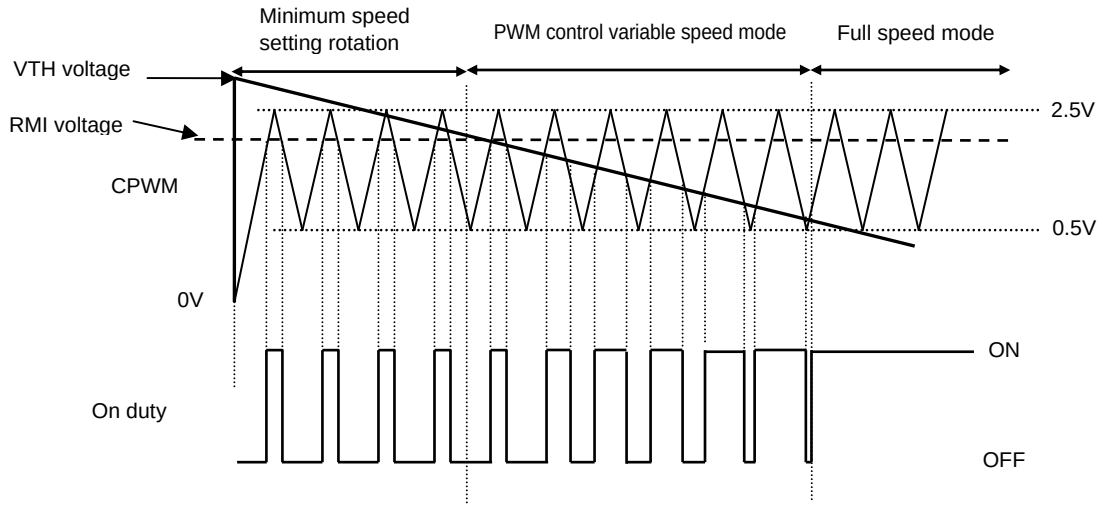
*9. **RMI pin**

This pin is the speed control minimum speed setting.

The minimum output duty is set by R3 and R4. Leave R4 open to have the motor stop when the duty is 0%.

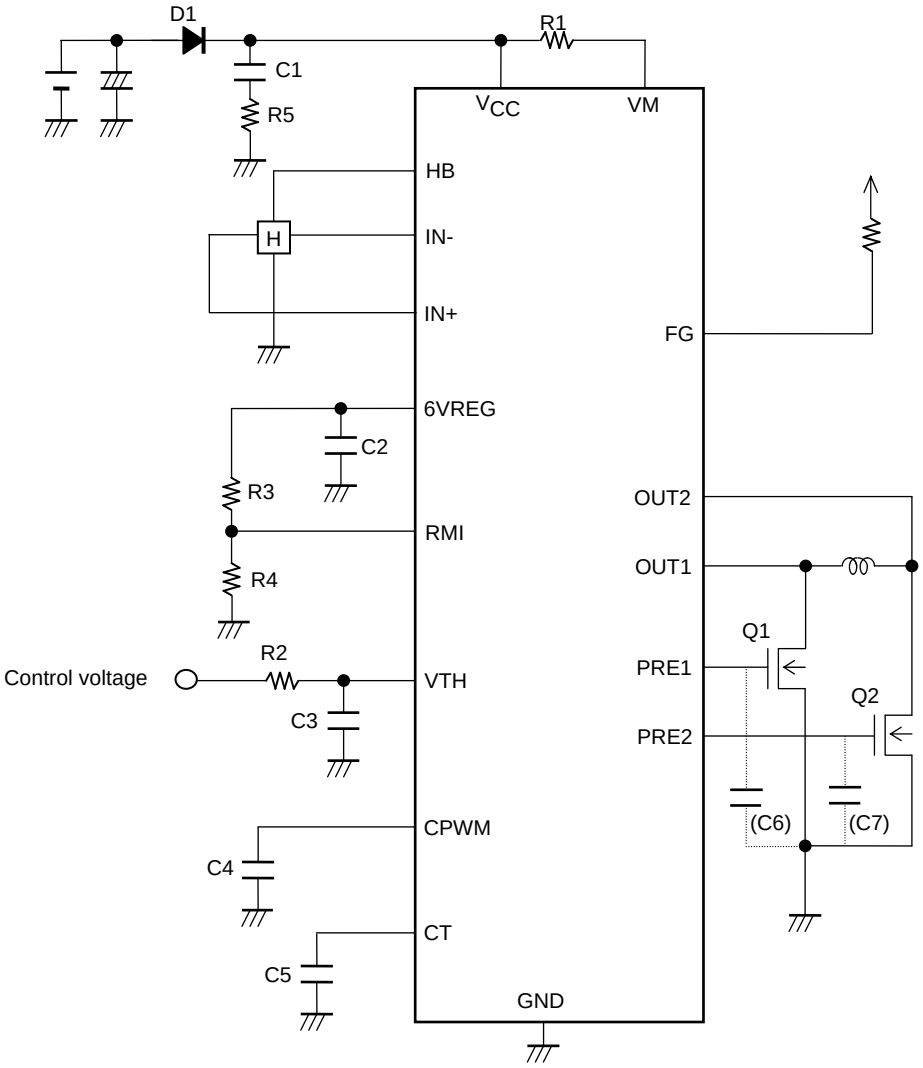
## Rotation Control Timing Chart



**Application Circuit Example 2**

Mounting circuit board (Component values are provided for reference purposes)

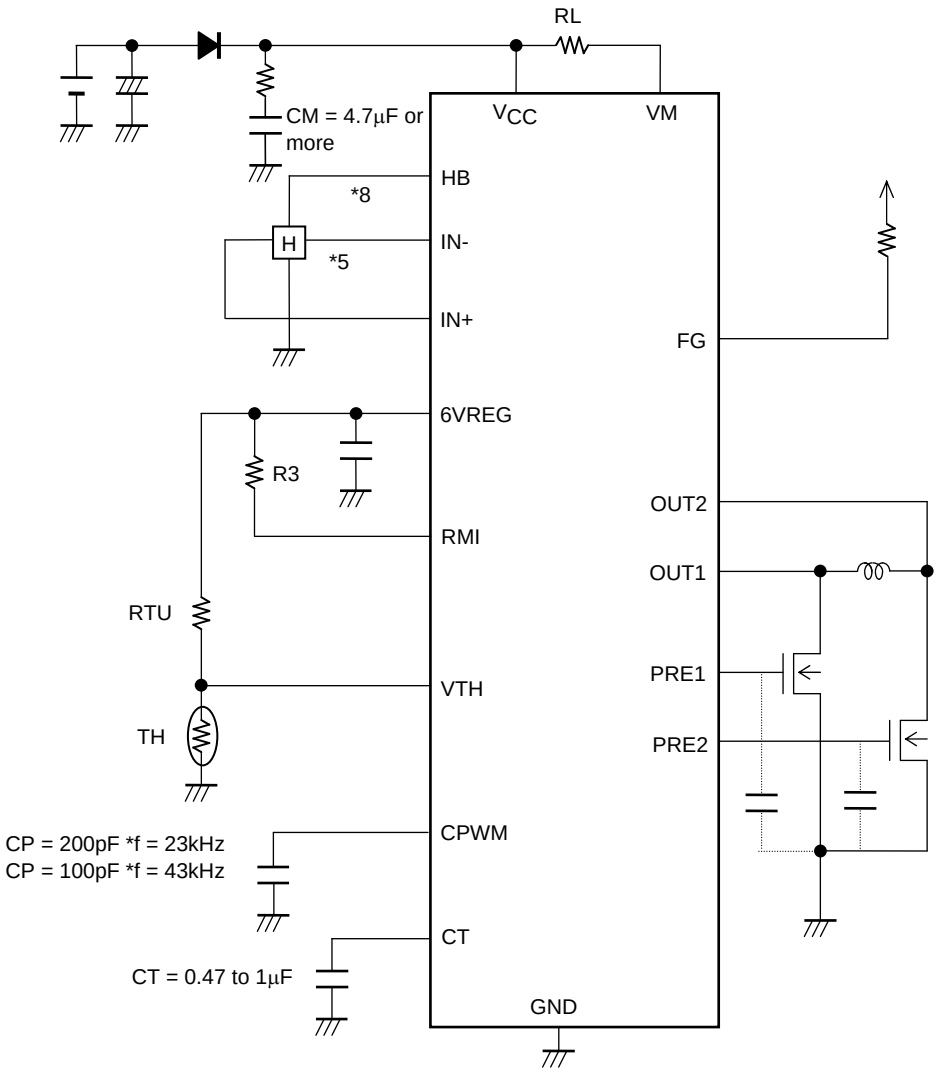



**Parts List**

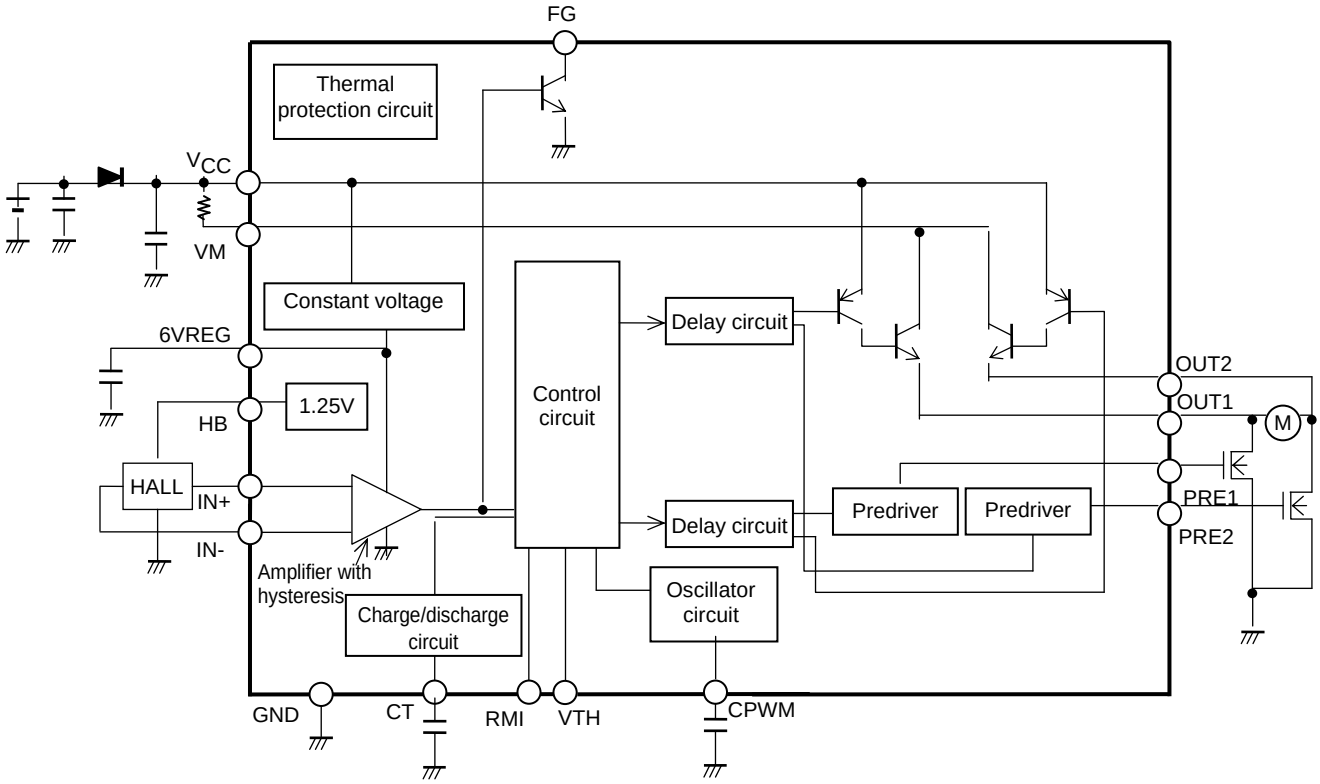
| | | |
|---|---|---|
| D1 | : SBM30-03-Tr (Our product) | |
| Q1, 2 | : CPH3418 (Our product) | |
| R1 | : 0.51Ω | size 3225 |
| R2 | : 15kΩ | size 1608 |
| R3 | : 39kΩ | size 1608 |
| R4 | : 20kΩ | size 1608 |
| R5 | : 2.2Ω | size 1608 |
| C1 | : 4.7μF/25V | size 3216 |
| C2 | : 2.2μF | size 1608 |
| C3 | : 2.2μF | size 1608 |
| C4 | : 220pF | size 1005 |
| C5 | : 0.47μF | size 1608 |
| C6, 7 | : No connection | |

**Application Circuit Example 3**

No minimum speed setting, thermistor input used



## Internal Equivalent Circuit Diagram




## ORDERING INFORMATION

| Device | Package | Wire Bond | Shipping (Qty / Packing) |
|---|---|---|---|
| LB11660FV-MPB-H | SSOP16 (225mil) (Pb-Free / Halogen Free) | Au-Wire | 90 / Fan-Fold |
| LB11660FV-TLM-H | SSOP16 (225mil) (Pb-Free / Halogen Free) | Au-Wire | 2000 / Tape & Reel |
| LB11660FV-W-AH | SSOP16 (225mil) (Pb-Free / Halogen Free) | Cu-Wire | 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