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# LV8862JA



ON Semiconductor®

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Bi-CMOS LSI

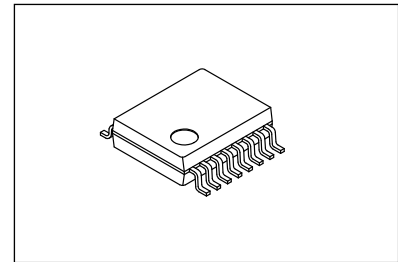
## Single-phase FAN Motor Driver

### Overview

LV8862JA is a driver IC used for single-phase fan motor. High-efficiency and low-noise are realized by reducing reactive power using Silent PWM. This IC's feature is low on-resistance  $0.6\Omega$  & High-efficiency. Therefore, it is optimal for high power fan motor and home appliance equipment.

### Feature

- Single-phase full wave operation by Silent PWM drive
- Speed is controllable by PWM input
- Hall bias output pin
- Integrated Quick Start Circuit
- FG (rotation detection)/ RD (lock detection) output pin (open drain output)
- Integrated current limiter circuit (limit at  $I_o=500\text{mA}$  with  $R_L=0.5\Omega$  connection, limit value is determined based on  $R_f$ )
- Integrated lock protector circuit and automatic recovery circuit
- Integrated thermal shut-down (TSD) circuit



SSOP16 (225mil)

### Typical Applications

- Fan motor units
- Desk top PCs
- Refrigerator
- Projectors

### Specifications

**Absolute Maximum Ratings** at  $T_a = 25^\circ\text{C}$ ,  $\text{GND} = 0\text{V}$

| Parameter                    | Symbol     | Conditions              | Ratings      | Unit             |
|------------------------------|------------|-------------------------|--------------|------------------|
| Maximum supply voltage       | VCC max    |                         | 20           | V                |
| OUT pin output current       | IOUT max   |                         | 1.5          | A                |
| Output withstand             | VOUT max   |                         | 20           | V                |
| RD/FG output pin withstand   | VRD/FG max |                         | 18           | V                |
| RD/FG output maximum current | IRD/FG max |                         | 10           | mA               |
| RGL output maximum current   | IRGL max   |                         | 5            | mA               |
| HB output maximum current    | IHB max    |                         | 10           | mA               |
| PWM input pin withstand      | VPWM max   |                         | 6            | V                |
| Allowable power dissipation  | Pd max     | On a specified board *1 | 0.8          | W                |
| Operating temperature        | Topr       | *2                      | -40 to + 95  | $^\circ\text{C}$ |
| Storage temperature          | Tstg       |                         | -55 to + 150 | $^\circ\text{C}$ |

\*1 Specified board: 76.1mm x 114.3mm x 1.6mm, glass epoxy board

\*2 Do not exceed  $T_{j\text{max}}=150^\circ\text{C}$

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.

### ORDERING INFORMATION

See detailed ordering and shipping information on page 12 of this data sheet.

# LV8862JA

## Recommended Operating Conditions at Ta = 25°C, GND = 0V

| Parameter                                   | Symbol  | Conditions                       | Ratings         | Unit |
|---|---------|----------------------------------|-----------------|------|
| Operating supply voltage range              | VCC op1 | Recommended supply voltage range | 3.6 to 16       | V    |
| Hall input common phase input voltage range | VICM    |                                  | 0.3 to VRGL-1.5 | V    |
| PWM pin input voltage range                 | PWM     |                                  | 0 to 5.5        | V    |
| SSW pin input voltage range                 | SSW     |                                  | 0 to VRGL       | V    |
| Input PWM frequency range                   | PWMF    |                                  | 20 to 50        | kHz  |

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, VCC = 12V, GND = 0V

| Parameter                              | Symbol   | Conditions                           | Ratings |      |      | Unit |
|--|----------|--------------------------------------|---------|------|------|------|
|  |          |                                      | min     | typ  | max  |      |
| Circuit consumption current            | ICC      | Active                               |         | 2.5  | 3.5  | mA   |
|  | ICCo     | Stand-by                             |         | 2.0  | 3.0  | mA   |
| RGL pin output voltage                 | VRGL     |                                      | 3.0     | 3.15 | 3.3  | V    |
| HB pin output voltage                  | VHB      | IHB=5mA                              | 1.16    | 1.25 | 1.28 | V    |
| Output ON resistance                   | Ron      | Io=1.0A, upper + lower ON resistance |         | 0.6  | 0.8  | Ω    |
| Hall input bias current                | IHIN     |                                      |         |      | 1.0  | μA   |
| Current limiter                        | VRF      |                                      | 220     | 250  | 280  | mV   |
| PWM pin input Low level                | VPWML    |                                      | 0       |      | 1.0  | V    |
| PWM pin input High level               | VPWMH    |                                      | 2.0     |      | VRGL | V    |
| PWM input minimum pulse width          | TPWM     |                                      | 1       |      |      | μSec |
| RD/FG output pin Low voltage           | VRD/FG   | IRD/FG=3mA                           |         | 0.22 | 0.30 | V    |
| FG output leakage current              | IRDL/FGL | VRD/FG=18V                           |         |      | 10   | μA   |
| FG comparator hysteresis width         | ΔVHYS    | including offset                     | ±5      | ±12  | ±18  | mV   |
| Output ON time in Lock-detection       | TACT     |                                      | 0.6     | 0.8  | 1.0  | Sec  |
| Output OFF time in Lock-detection      | TDET     |                                      | 6       | 7.2  | 9    | Sec  |
| Output ON/OFF ratio in Lock-detection  | TRTO     | TRTO=TDET/TACT                       | 7.5     | 9.0  | 11.0 |      |
| Thermal shutdown operating temperature | TSD      | *Design guarantee                    |         | 180  |      | °C   |
| Thermal shutdown hysteresis width      | ΔTSD     | *Design guarantee                    |         | 40   |      | °C   |

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.

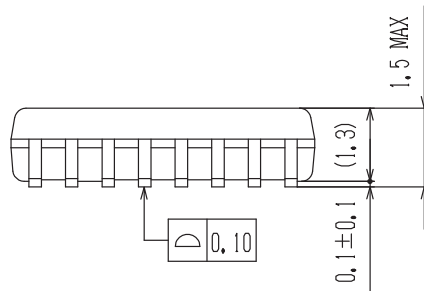
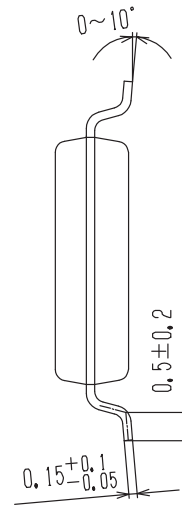
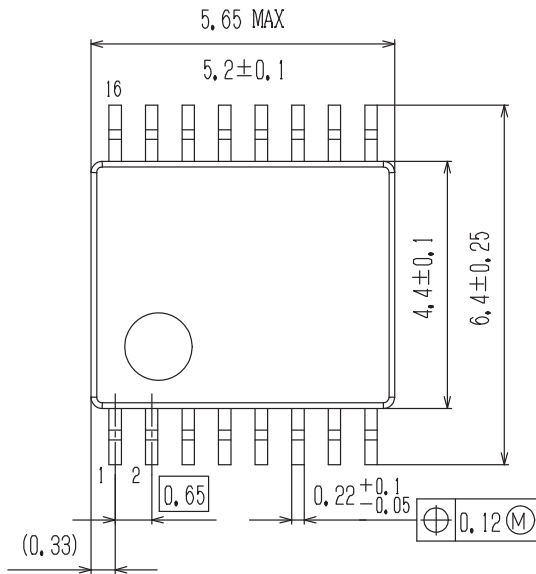
### Truth table

| Operating state              | IN1 | IN2 | PWM | OUT1 | OUT2 | FG  | RD  |
|------------------------------|-----|-----|-----|------|------|-----|-----|
| Rotation – drive mode        | L   | H   | H   | H    | L    | L   | L   |
|                              | H   | L   |     | L    | H    | OFF | L   |
| Rotation – regeneration mode | L   | H   | L   | L    | L    | L   | L   |
|                              | H   | L   |     | L    | L    | OFF | L   |
| Lock protector               | L   | H   | -   | OFF  | L    | L   | OFF |
|                              | H   | L   |     | L    | OFF  | OFF | OFF |

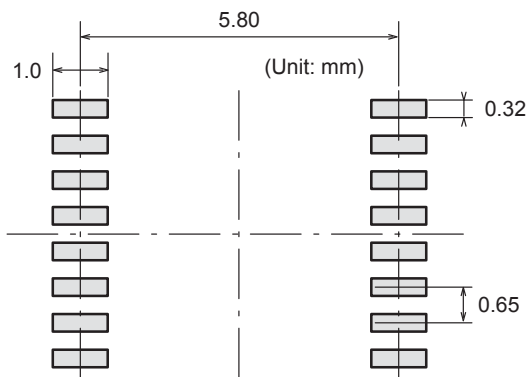
Package Dimensions

unit : mm

SSOP16 (225mil)  
CASE 565AM  
ISSUE A



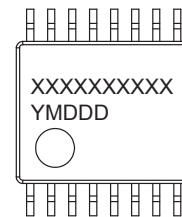
SOLDERING FOOTPRINT\*



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\*

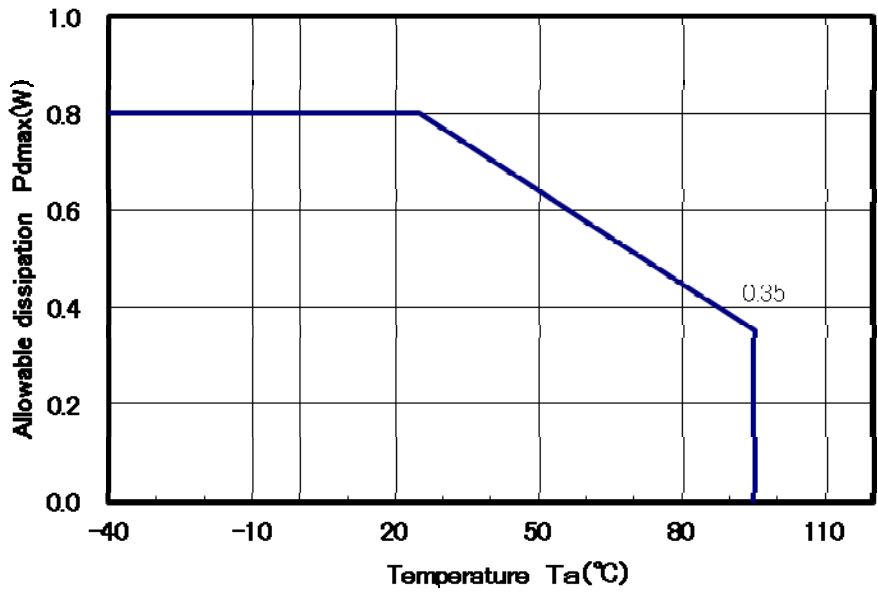


XXXXX = Specific Device Code  
Y = Year  
M = Month  
DDD = Additional Traceability Data

\*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.

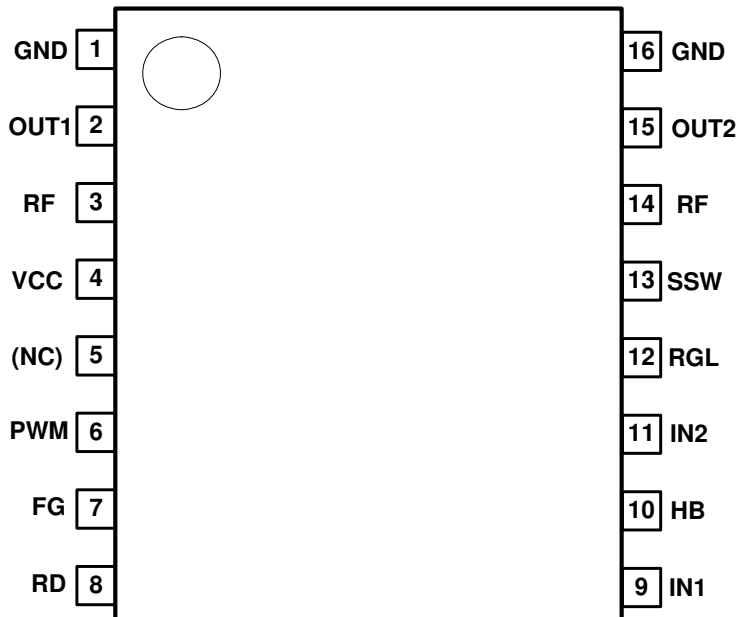
Pdmax-Ta

Specified board: 76.1mm x 114.3mm x 1.6mm, glass epoxy board

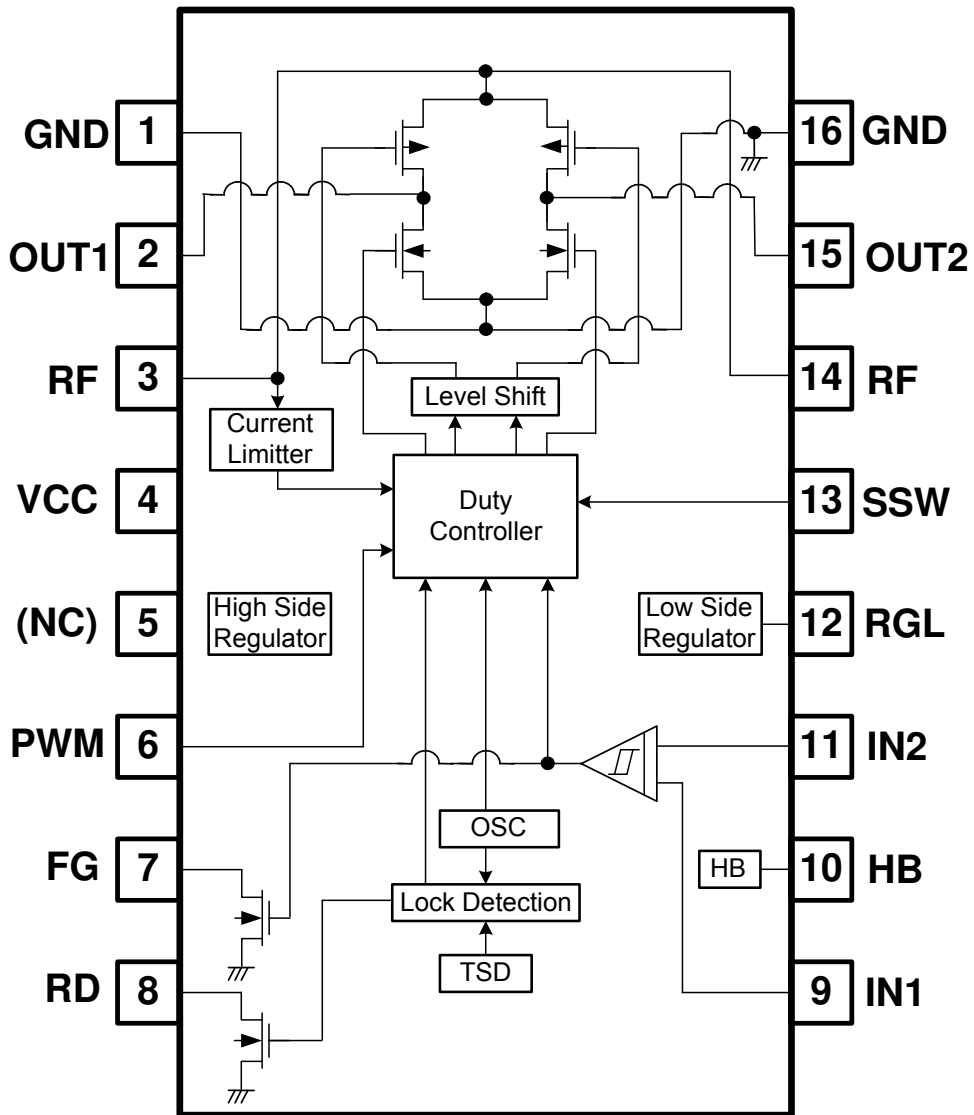


Pin Assignment

SSOP16(225mil)  
Top view



Block diagram



**Pin function**

\*On circuit board,  $\triangle$  means VCC,  $\uparrow$  means RGL.

| No.     | Pin name | Function  | Equivalent circuit |
|---------|----------|---|--------------------|
| 2       | OUT1     | Output pin for motor driver   |                    |
| 15      | OUT2     |   |                    |
| 3<br>14 | RF       | Resistive connection pin for current limiter  |                    |
| 4       | VCC      | Power supply pin  |                    |
| 6       | PWM      | Input pin for PWM control<br>*OPEN: pull up to High<br>* When input is High → output is High<br>When input is Low → output is Low |                    |
| 7       | FG       | FG (rotation detection) pulse output pin  |                    |
| 8       | RD       | RD (lock detection) signal output pin<br>*During rotation → output is Low<br>During lock → output is High                         |                    |
| 9       | IN1      | Hall input + pin  |                    |
| 11      | IN2      | Hall input - pin  |                    |

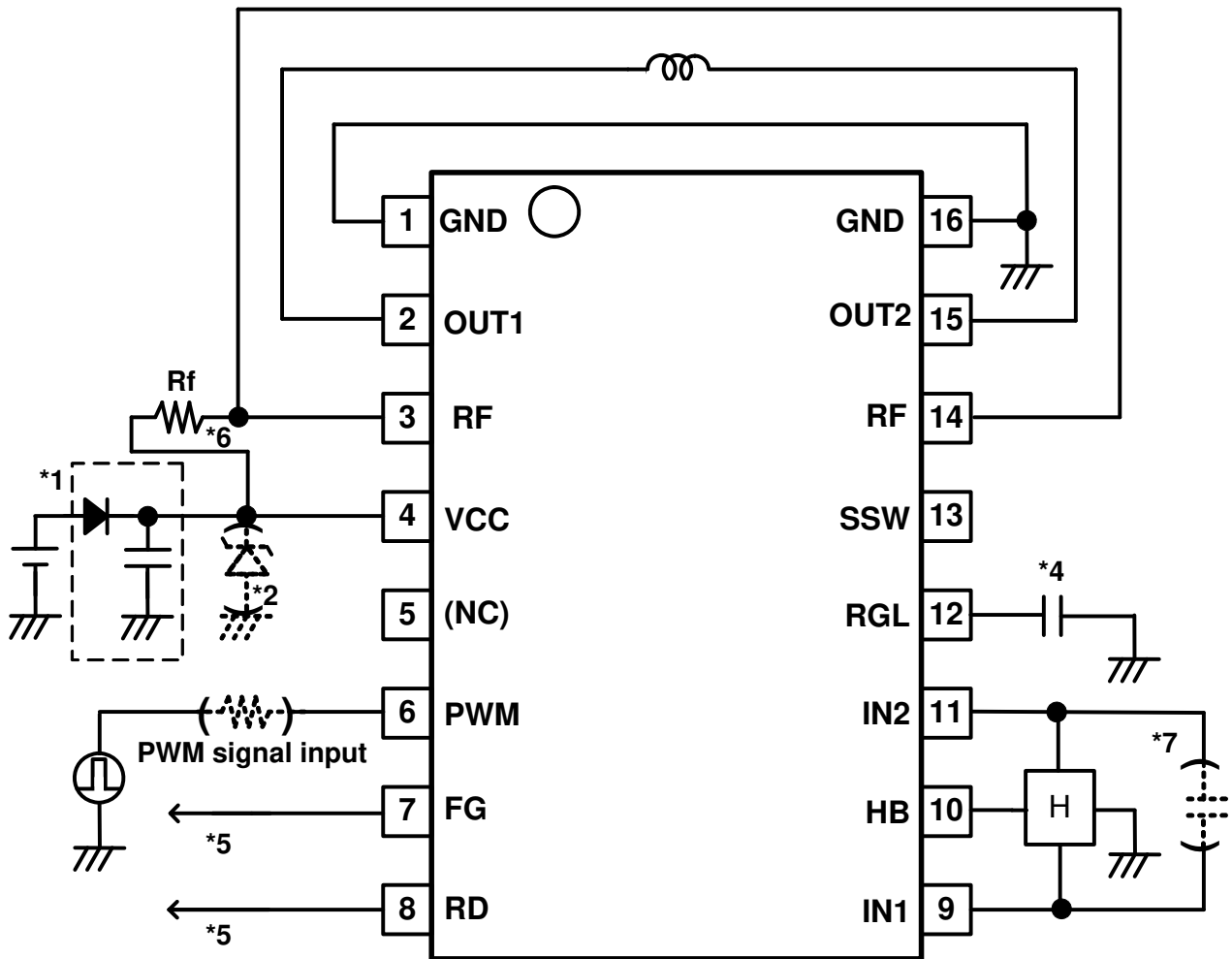
Continue to the next page

From the previous page

| No.     | Pin name | Function   | Equivalent circuit |
|---------|----------|--|--------------------|
| 10      | HB       | Hall bias output pin   |                    |
| 12      | RGL      | Regulator voltage output pin for internal circuit and lower output Tr driver   |                    |
| 13      | SSW      | Voltage input pin for control between soft switches<br>*OPEN: pin voltage is middle.<br>*Soft switch zone is changed by short to RGL or GND. |                    |
| 1<br>16 | GND      | Ground pin   |                    |
| 3<br>14 | RF       | Resistive connection pin for current limiter   |                    |

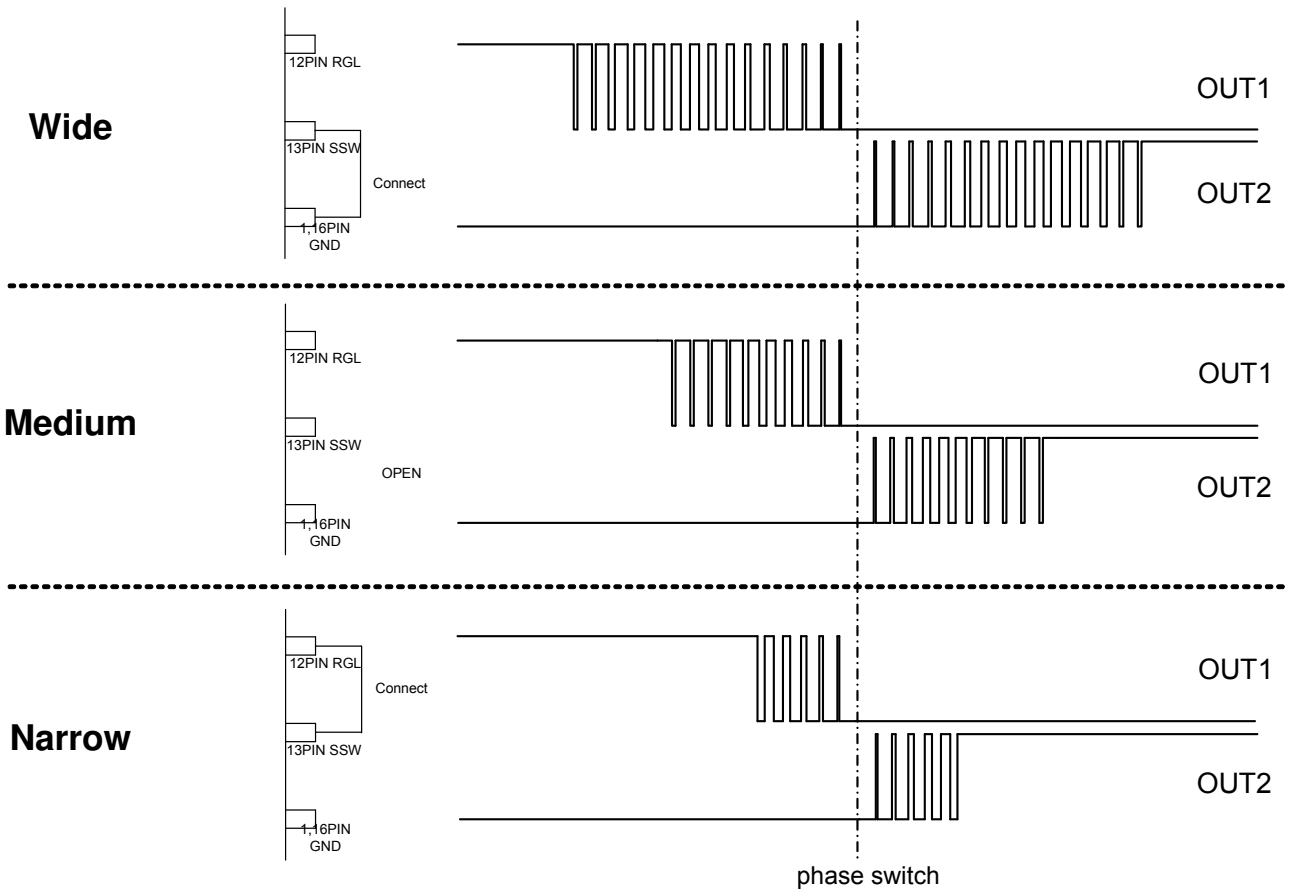


Sample application circuit



- \*1 When diode  $D_1$  is used to prevent destruction of IC from reverse connection, make sure to implement the large capacitor  $C_1$  to secure regenerative current route.
- \*2 If kickback at a phase change is greater, insert zener diode between GND and VCC or implement the larger capacitor between GND and VCC mentioned in \*1.
- \*4 Make sure to implement enough capacitance 0.1 $\mu$ F or higher between RGL pin and GND pin for stable performance.
- \*5 FG pin and RD pin are open drain output. Keep the pins open when unused.
- \*6 The current limiter is activated when the current detection resistor voltage exceeds 250mV between RF and VCC. Where  $R_L=0.5\Omega$ , current limiter is activated at  $I_o=500mA$ . Setting is made using  $R_f$  resistance.
- \*7 Hall element outputs stable hall signal with good temperature characteristic when it is biased with constant voltage from HB pin. If you wish to alleviate heating of IC, do not use HB pin. When you do not use this Pin (Pin HB), pull down with resistor of around 10k $\Omega$ (recommended).  
To defend signal against the noise, it is necessary to wire as short as possible from hall sensor to each pin and to connect the capacitor between IN1 and IN2. Value from 1,000pF to 10,000pF is recommended for the capacitor. But its value should be selected in consideration with the actual motor action.

**Adjustment of soft-switching width**  
**LV8862JA soft-switching wide select**



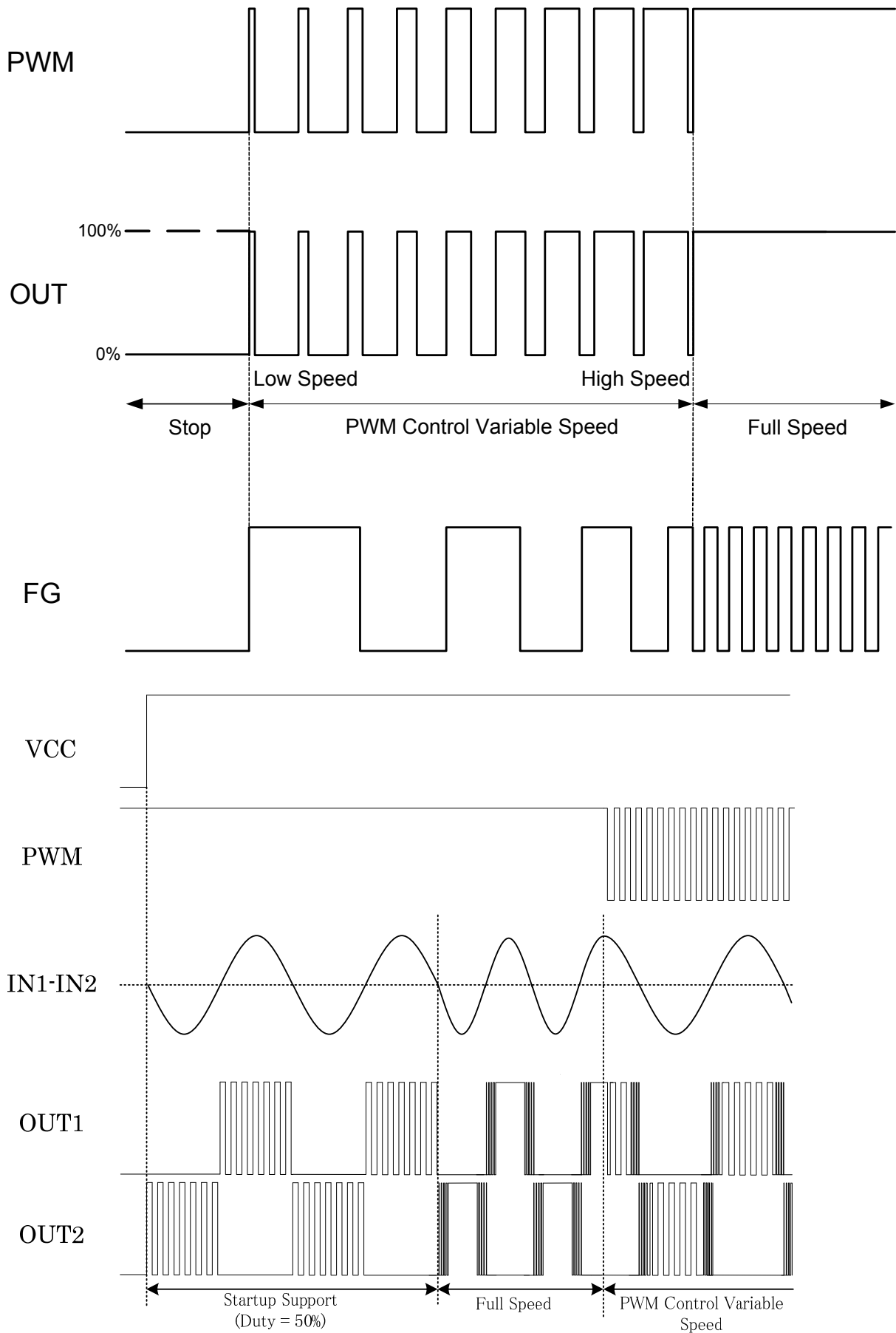
LV8862JA realizes high efficiency and low noise by controlling reactive power using soft switch before and after phase switch by variable PWM-duty.

The width of soft switch before and after switching is controlled by SSW pin voltage. Therefore, it is adjustable by connecting to SSW and RGL or GND or open. .

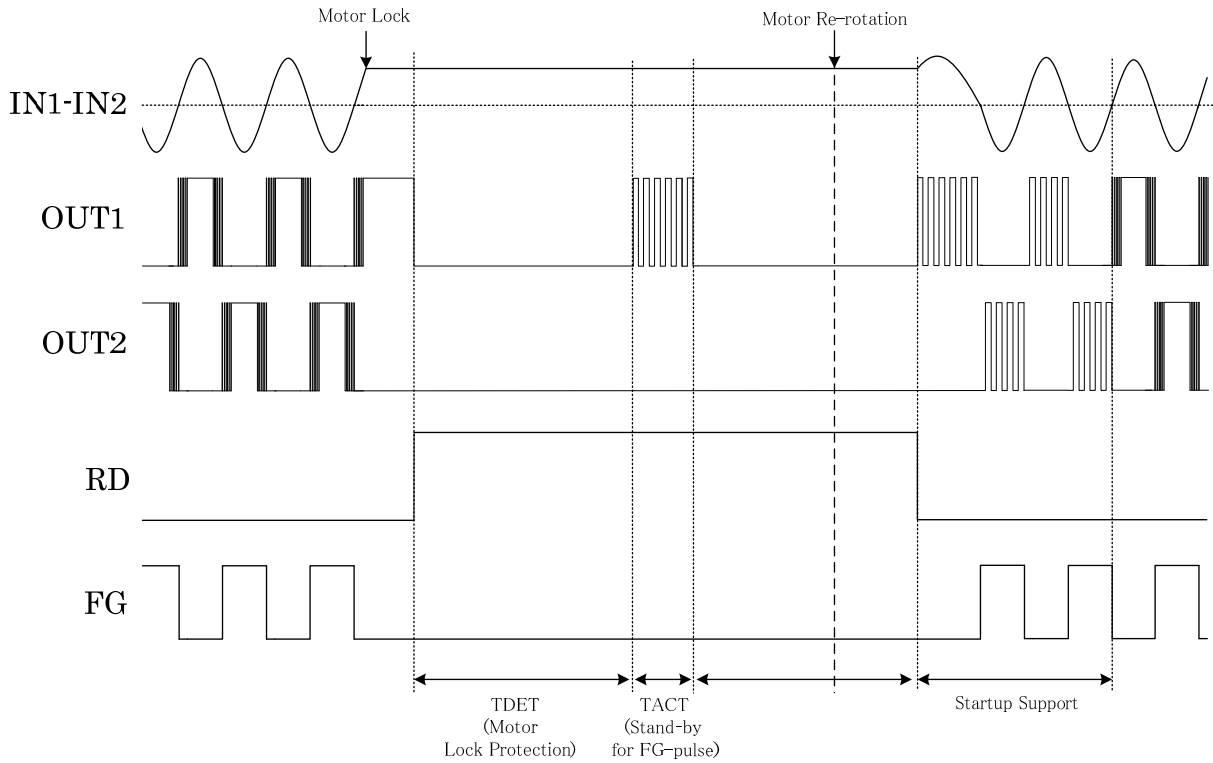
When the motor rotation speed is very high, there is possibility to show unstable soft-switching waveform.

**Description of operation**

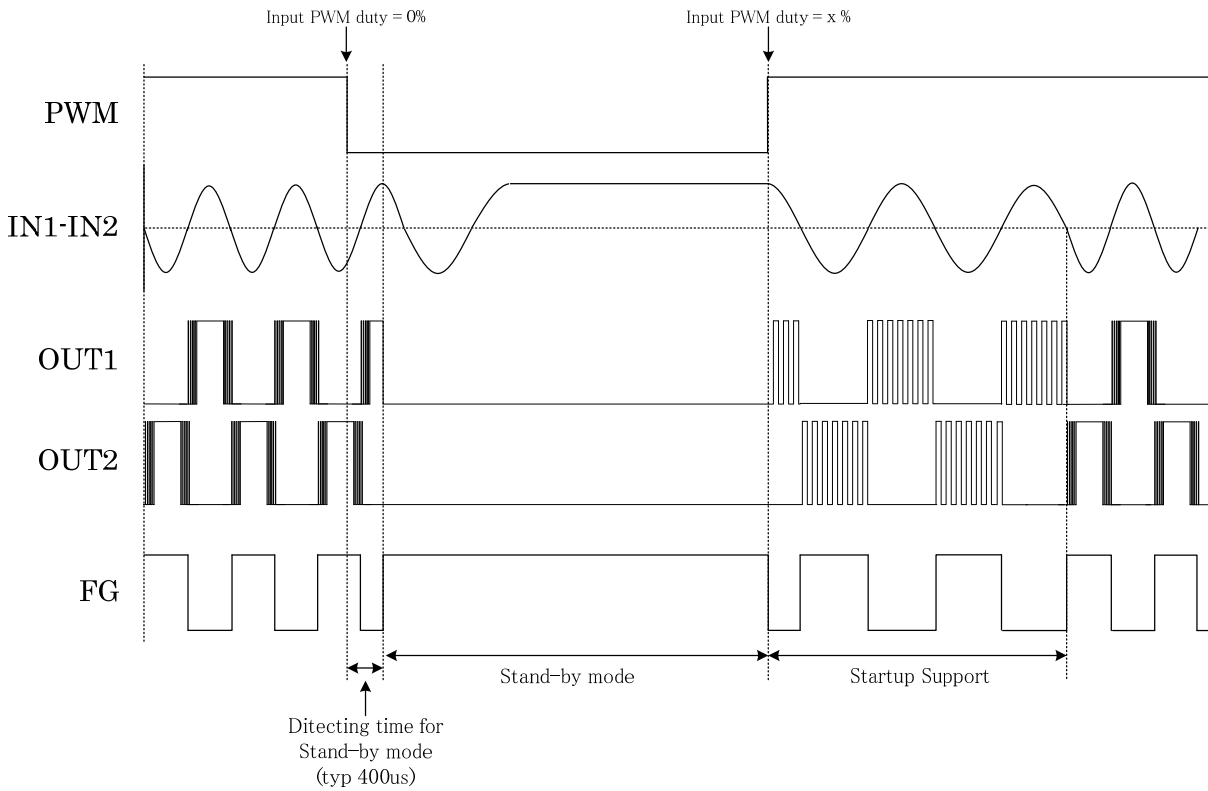
•PWM speed control waveform



•Lock protection operation waveform



•Stand-by mode operation waveform



**ORDERING INFORMATION**

| Device      | Package                                     | Shipping (Qty / Packing) |
|-------------|---|--------------------------|
| LV8862JA-AH | SSOP16 (225mil)<br>(Pb-Free / Halogen Free) | 2000 / Tape & Reel       |

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