

LB11970FV

Single-phase Full-wave Driver for Fan Motor

Overview

The LB11970FV is a single-phase full-wave driver for fan motor.

Functions

- Single-phase full-wave drive (16V to 1.2A output transistor incorporated)
- Variable speed function using thermistor input and external signal incorporated
 - Enables silent and low-vibration variable speed control through direct PWM control with separately-excited upper Tr
- Current limiter circuit (limit at $I_{O}=480\text{mA}$ with $R_L=1\Omega$ connection, the limiter value determined with Rf)
- Kick-back absorption circuit incorporated
- Low-consumption, low-loss, and low-noise drive enabled by the soft switching circuit during phase shift
- Regeneration Di incorporated with less external parts
- HB incorporated
- Lock protection and automatic reset functions incorporated
- FG (rotation detection) output
- Thermal shutdown circuit incorporated

Applications

- Personal computer power supply systems
- CPU cooling fan systems

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$ (Note1)

| Parameter | Symbol | Conditions | Ratings | Unit |
|--|----------------------|-----------------------------|------------|------|
| V_{CC} maximum supply voltage | $V_{CC\text{ max}}$ | | 17 | V |
| VM maximum supply voltage | VM max | | 17 | V |
| OUT pin maximum output current | $I_{OUT\text{ max}}$ | | 1.2 | A |
| OUT pin output withstand voltage | $V_{OUT\text{ max}}$ | | 18 | V |
| HB maximum output current | HB | | 10 | mA |
| VTH, RMI input pin withstand voltage | VTH RMI max | | 7 | V |
| P-IN input pin withstand voltage | VP-IN max | | V_{CC} | V |
| FG output pin output withstand voltage | VFG max | | 18 | V |
| FG output current | IFG max | | 10 | mA |
| Allowable power dissipation | Pd max | Specified substrate (Note2) | 0.8 | W |
| Operating temperature range | Topr | | -30 to 90 | °C |
| Storage temperature range | Tstg | | -55 to 150 | °C |

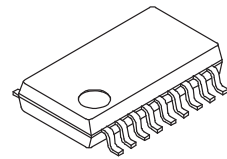
1. Stresses exceeding those listed in the Maximum Rating table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

2. Specified substrate: 30mm×30mm×0.8mm, paper phenol.



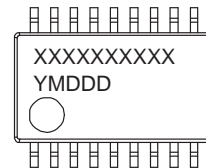
ON Semiconductor®

www.onsemi.com



SSOP18 (225mil)

GENERIC MARKING DIAGRAM*



XXXXXX = Specific Device Code

Y = Year

M = Month

DDD = Additional Traceability Data

ORDERING INFORMATION

See detailed ordering and shipping information on page 8 of this data sheet.

LB11970FV

Recommended Operating Ranges at Ta = 25°C (Note3)

| Parameter | Symbol | Conditions | Ratings | Unit |
|---|-----------------|------------|----------------------|------|
| V _{CC} supply voltage | V _{CC} | | 4.5 to 16 | V |
| VM supply voltage | VM | | 3.5 to 16 | V |
| VTH, RMI input level voltage range | VTH, RMI | | 0 to 6 | V |
| P-IN input level voltage range | VP-IN | | 0 to V _{CC} | V |
| Triangular wave input range | VRM | | 0.5 to 4 | V |
| Hall input common phase input voltage range | VICM | | 0.2 to 3 | V |

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, R_f = 0Ω, unless otherwise specified. (Note4)

| Parameter | Symbol | Conditions | Ratings | | | unit |
|-----------------------------------|------------------|--|---------|------|------|------|
| | | | min | typ | max | |
| Circuit current | I _{CC1} | During drive | 12 | 15 | 18 | mA |
| | I _{CC2} | During lock protection | 11 | 14 | 17 | mA |
| HB voltage | VHB | IHB=5mA | 1.12 | 1.22 | 1.32 | V |
| 6VREG voltage | V6VREG | I6VREG=5mA | 5.85 | 5.95 | 6.10 | V |
| CT pin H level voltage | V _{CTH} | | 3.4 | 3.6 | 3.8 | V |
| CT pin L level voltage | V _{CTL} | | 1.4 | 1.6 | 1.8 | V |
| CT pin charge current | I _{CT1} | | 1.8 | 2.2 | 2.6 | μA |
| CT pin discharge current | I _{CT2} | | 0.18 | 0.22 | 0.26 | μA |
| CT charge/discharge current ratio | R _{CT} | | 8 | 10 | 12 | |
| OUT output L saturation voltage | V _{OL} | I _O =200mA | | 0.1 | 0.2 | V |
| OUT output H saturation voltage | V _{OH} | I _O =200mA, R _f =1Ω | | 0.6 | 0.8 | V |
| Current limiter | VRF | | | 480 | | mV |
| Hall input sensitivity | VHN | Zero peak value (including offset and hysteresis) | | 10 | 20 | mV |
| FG output pin L voltage | VFG | IFG=5mA | | 0.2 | 0.3 | V |
| FG output pin leak current | IFGL | VFG=7V | | | 30 | μA |
| Overheat protection circuit | THD | Design guarantee value (Note5) | | 180 | | °C |

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.

5. Design target value and no measurement was made.

LB11970FV

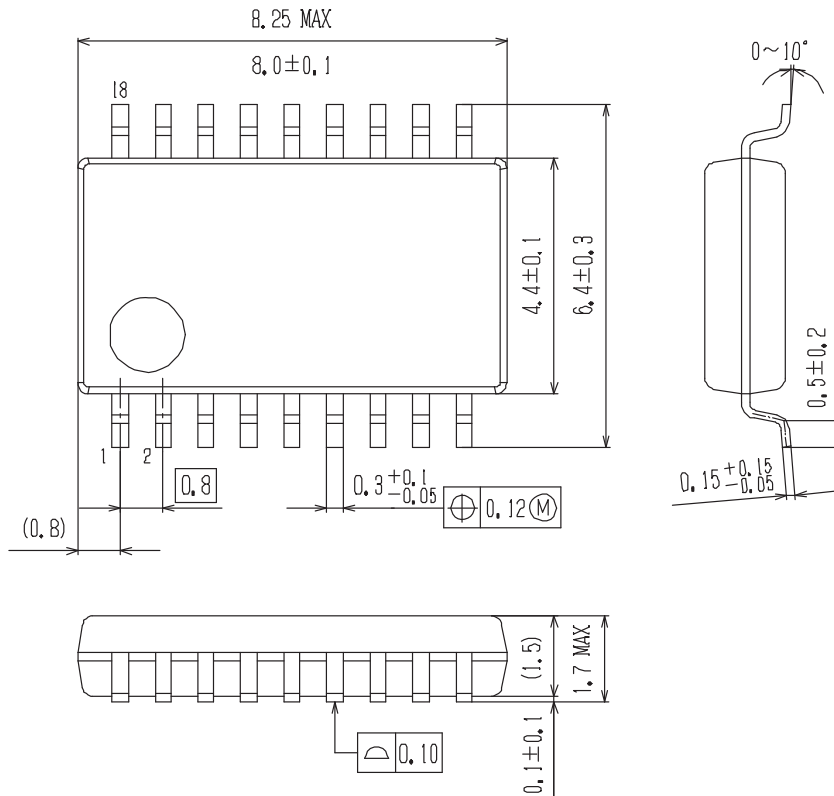
Package Dimensions

unit : mm

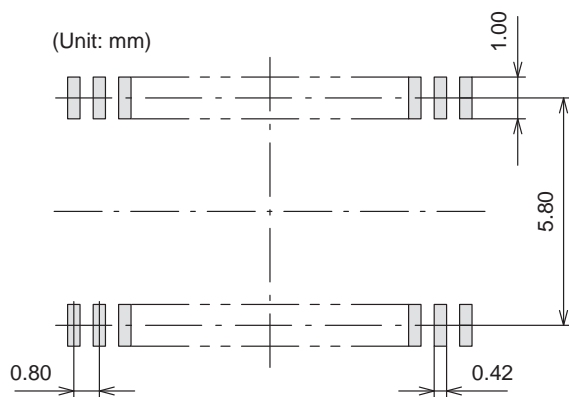
SSOP18 (225 mil)

CASE 565AX

ISSUE A



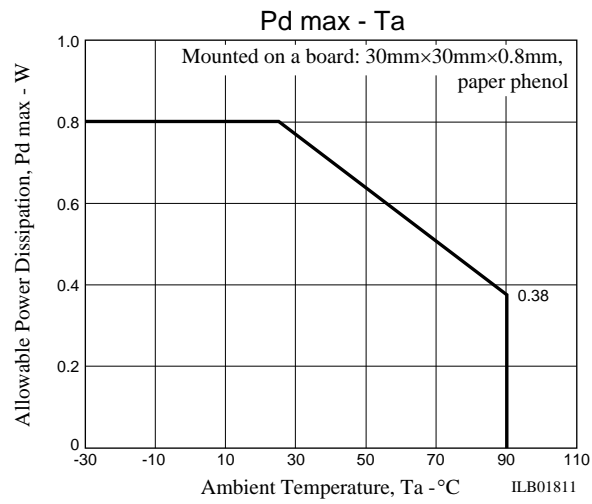
SOLDERING FOOTPRINT*



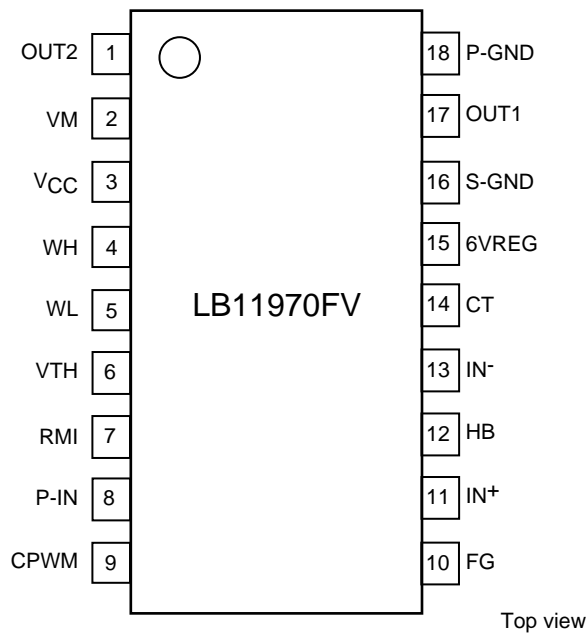
NOTE: The measurements are not to guarantee but for reference only.

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

LB11970FV



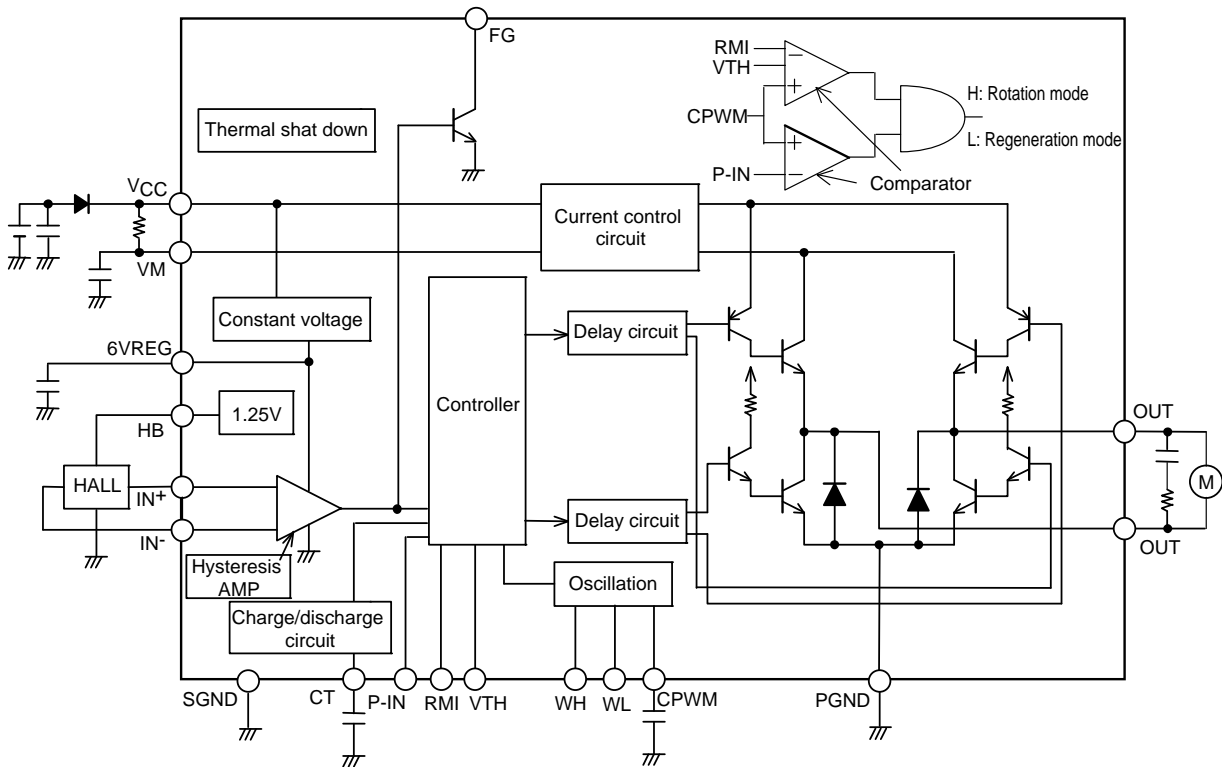
Pin Assignment



PGND: Motor system GND
SGND: Control system GND

LB11970FV

Equivalent Circuit Diagram



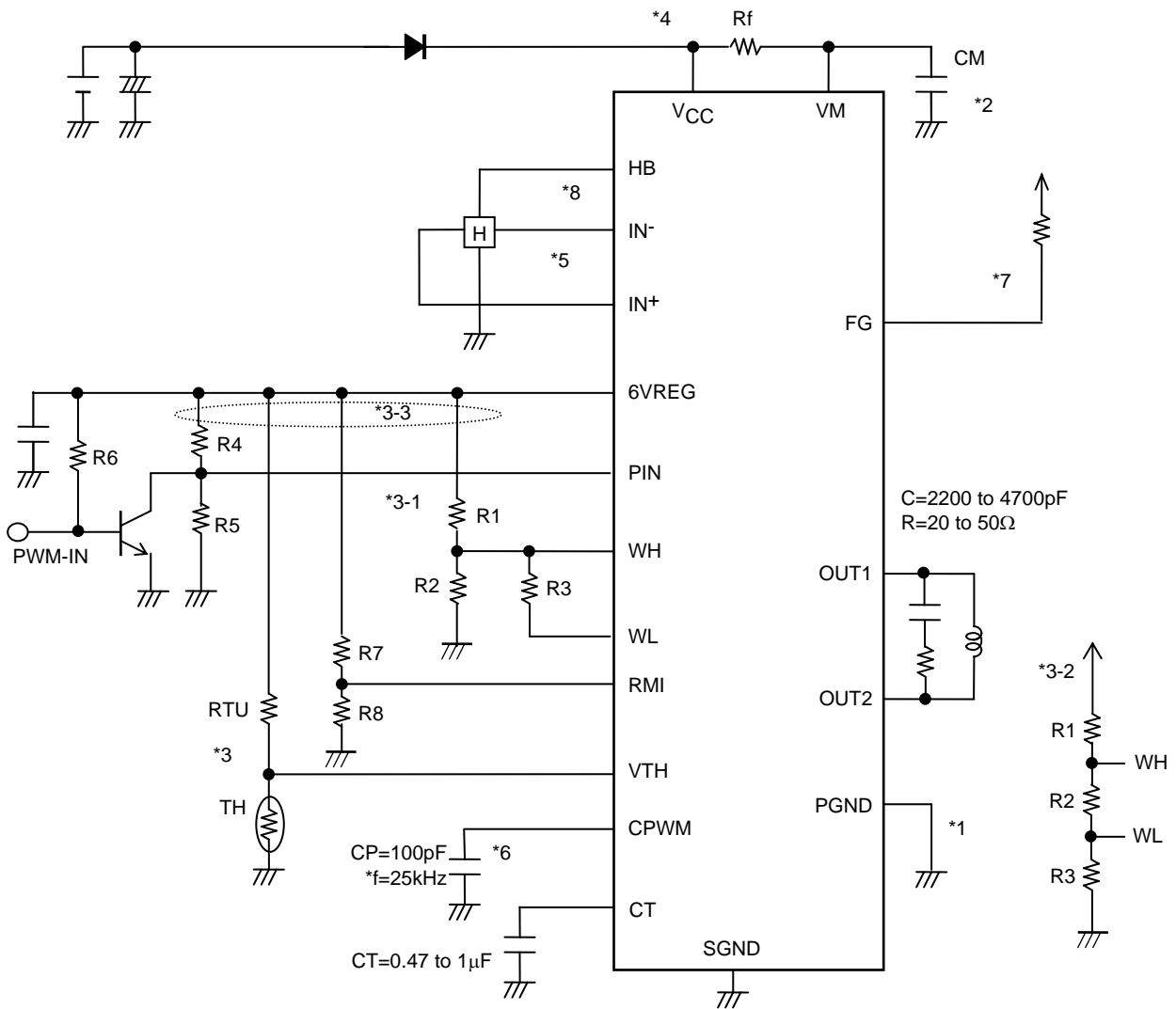
Truth Table

| VTH | PIN | IN- | IN+ | CT | OUT1 | OUT2 | FG | Mode |
|-------------|-----|-----|-----|----|------|------|-----|--|
| L (OPEN) | L | H | L | L | H | L | L | Running - drive |
| | L | L | H | | L | H | OFF | |
| H | L | H | L | | OFF | L | L | Running - regeneration |
| | L | L | H | | L | OFF | OFF | |
| - | H | H | L | L | OFF | L | L | Output regeneration mode with external signal |
| - | H | L | H | | L | OFF | OFF | |
| - | - | H | L | H | OFF | L | L | Lock protection |
| - | - | L | H | H | L | OFF | OFF | |

VTH, P-IN = L means VTH, P-IN < CPWM VTH, P-IN = H means VTH, P-IN > CPWM

LB11970FV

Application Circuit Example



LB11970FV

*1. Power supply - GND wiring

PGND is connected to the motor power system while SGND is connected to the control circuit power system.

Wiring is made separately for PGND and SGND, and external parts of each control system are connected to SGND.

*2. Power stabilization capacitor for regeneration

CM capacitor is a power stabilizing capacitor for PWM drive and kick-back absorption and has the capacitance of 4.7 μ F or more. Since this IC performs current regeneration with the lower Tr through switching of the upper Tr, connect CM with the thick and shortest possible pattern between VM and PGND.

*3. Setting of the temperature detection variable speed

Setting of the triangular wave oscillation voltage

The rotation speed variable range for the temperature is set with the triangular wave oscillation voltage.

There are two setting methods as follows:

3-1 The upper voltage (VCPH) of triangular wave is determined by $V[\text{voltage of the R1 connection counterpart}] \times (R2/(R1+R2))$ and the lower voltage (VCPL) of triangular wave is determined by $V \times ((R2/R3) / (R1+R2/R3))$.

3-2 The upper voltage (VCPH) of triangular wave is determined by $V \times ((R2+R3) / (R1+R2+R3))$ and the lower voltage (VCPL) of triangular wave is determined by $V \times (R2/(R1+R2))$.

Setting of the thermistor

The resistance (RTU from VCC or 6VREG and the voltage generated through division of thermistor (TH) are input in the VTH pin. When the voltage at the VTH pin drops below VCPL due to temperature change, the full speed (thermistor input speed control side only) is obtained.

To set the full speed with the thermistor tripping, connect each pin of 3-3 to VCC and each input voltage is generated by divided resistance from VCC. When the thermistor trips and the VTH pin is pulled up to VCC, the full speed (thermistor input speed control side only) is obtained.

*4. Setting the current limiter

The current limiter is activated when the voltage between current detection resistors exceeds 0.48V between VCC and VM.

The current limiter is activated at $I_O = 480\text{mA}$ when $R_L = 1\Omega$. Setting is made with the Rf resistance.

Short-circuit VCC and VM when the current limiter is not to be used.

When 12V is used, the current limiter must be applied at 1A or less if the coil resistance is 10 Ω or less.

*5. Hall input

Wiring must be as short as possible to prevent carrying of noise. The Hall input circuit is a comparator with hysteresis of 20mV. The Hall input level is recommended to be three times (60mVp-p) or more of this hysteresis.

*6. Capacitor to set the PWM oscillation frequency

Oscillation with $f = 25\text{kHz}$ occurs at $CP = 100\text{pF}$ and PWM voltage width of 1.6V, and becomes the reference frequency of PWM.

*7. FG output

This is the open collector output, enabling detection of the rotation speed using the FG output corresponding to the phase shift. Keep this output OPEN when not used.

*8. HB pin

Hall element bias pin, which is a 1.22V constant-voltage output pin

*9. RMI pin

Minimum speed setting pin for thermistor speed control, which must be pulled up with 6 VREG when not used.

By connecting the capacitor, the time to ignore thermistor input at startup can be set.

*10. PIN pin

Direct PWM speed control pin. Pull down the P-IN input to GND when not using this pin.

The lowest output DUTY setting is made with R4 and R5. Keep R5 open for stop with DUTY at 0%.

LB11970FV

ORDERING INFORMATION

| Device | Package | Wire Bond | Shipping(Qty/Packing) |
|-----------------|--|-----------|-----------------------|
| LB11970FV-MPB-H | SSOP18(225mil) (Pb-Free / Halogen Free) | Au-wire | 60 / Fan-fold |
| LB11970FV-TLM-H | SSOP18(225mil) (Pb-Free / Halogen Free) | Au-wire | 2000 / Tape & Reel |
| LB11970FV-W-AH | SSOP18(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

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.