

Monolithic Digital IC 3-phase Sensor Less Motor Driver

The LB11685AV is a three-phase full-wave current-linear-drive motor driver IC. It adopts a sensor less control system without the use of a Hall Effect device. For quieter operation, the LB11685AV features a current soft switching circuit and be optimal for driving the cooling fan motors used in refrigerators, etc.

- Three-phase Full-wave Linear Drive (Hall Sensor-less Method)
- Built-in Current Limiter Circuit
- Built-in Three-phase Output Voltage Control Circuit
- Built-in Motor Lock Protection Circuit
- Motor Lock Protection Detection Output
- FG Output Made by Back EMF
- Built-in Thermal Shut Down Circuit
- Beat Lock Prevention Circuit

| Parameter | Symbol | Conditions | Ratings | Unit |
|-----------------------------|-----------------------|-----------------------------|--------------------------|--------------------|
| Maximum Supply Voltage | V_{CC} max | | 19 | V |
| Input Applied Voltage | V_{IN} max | | -0.3 to $V_{CC} + 0.3$ | V |
| Maximum Output Current | I_O max (Note 1) | | 1.2 | A |
| Allowable Power Dissipation | P_d max | Mounted on a board (Note 2) | 1.05 | W |
| Operating Temperature | T_{opr} | | -40 to $+85$ | $^{\circ}\text{C}$ |
| Storage Temperature | T_{stg} | | -55 to $+150$ | $^{\circ}\text{C}$ |
| Junction Temperature | T_j 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.

1. The I_0 is a peak value of motor-current.
2. Specified board: 76.1 mm × 114.3 mm × 1.6 mm, glass epoxy board.

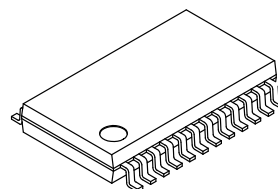
CAUTION: Absolute maximum ratings represent the value which cannot be exceeded for any length of time.

CAUTION: Even when the device is used within the range of absolute maximum ratings, as a result of continuous usage under high temperature, high current, high voltage, or drastic temperature change, the reliability of the IC may be degraded. Please contact us for the further details.

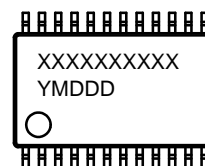


ON Semiconductor®

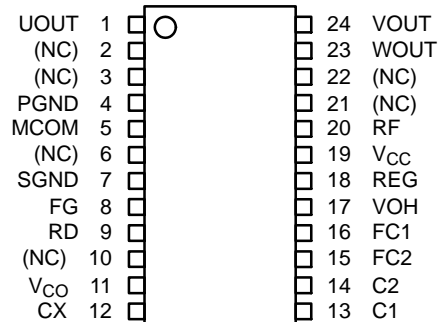
www.onsemi.com



SSOP24J
CASE 565AS



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



See detailed ordering and shipping information on page 7 of this data sheet.

LB11685AV

RECOMMENDED OPERATING CONDITIONS ($T_A = 25^\circ\text{C}$)

| Symbol | Parameter | Conditions | Ratings | Unit |
|--------------------|----------------------------|------------|-------------|------|
| V_{CC} | Recommended Supply Voltage | | 12.0 | V |
| $V_{CC\text{ op}}$ | Operating Supply Voltage | | 4.5 to 18.0 | 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 ($T_C = 25^\circ\text{C}$ unless otherwise noted)

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|--|---|-------|-------|--------------|------------------|
| I_{CC} | Supply Current | $FC1 = FC2 = 0\text{ V}$ | 5 | 10 | 20 | mA |
| VREG | Internal Regulate Voltage | | 3.0 | 3.3 | 3.6 | V |
| VOSOUR | Output Voltage (Source) | $I_O = 0.8\text{ A}$ (Note 5) | | 1.3 | 1.7 | V |
| VOSINK | Output Voltage (Sink) | $I_O = 0.8\text{ A}$ (Note 5) | | 0.5 | 1.3 | V |
| VOLIM | Current Limiter | | 0.268 | 0.300 | 0.332 | V |
| VINCOM | MCOM Pin Common-input Voltage Range | | 0 | | $V_{CC} - 2$ | V |
| ICOM+ | MCOM Pin Source Current for Hysteresis | $MCOM = 7\text{ V}$ | 30 | | 80 | μA |
| ICOM- | MCOM Pin Sink Current for Hysteresis | $MCOM = 7\text{ V}$ | 30 | | 80 | μA |
| RTCOM | MCOM Pin Hysteresis Current Ratio | $RTCOM = ICOM+ / ICOM-$ | 0.6 | | 1.4 | |
| I_{VCO} | VCO Input Bias Current | $V_{CO} = 2.3\text{ V}$ | | | 0.2 | μA |
| $f_{VCO\text{min}}$ | VCO Oscillation Minimum Frequency | $V_{CO} = 2.1\text{ V}$, $CX = 0.015\text{ }\mu\text{F}$ Design target (Note 4) | | 930 | | Hz |
| $f_{VCO\text{max}}$ | VCO Oscillation Maximum Frequency | $V_{CO} = 2.7\text{ V}$, $CX = 0.015\text{ }\mu\text{F}$ Design target (Note 4) | | 8.6 | | kHz |
| I_{CX} | CX Charge/Discharge Current | $V_{CO} = 2.5\text{ V}$, $CX = 1.6\text{ V}$ | 70 | 100 | 140 | μA |
| ΔV_{CX} | CX Hysteresis Voltage | | 0.35 | 0.55 | 0.75 | |
| IC1(2)+ | C1 (C2) Charge Current | $V_{CO} = 2.5\text{ V}$, $C1(2) = 1.3\text{ V}$ | 12 | 20 | 28 | μA |
| IC1(2)- | C1 (C2) Discharge Current | $V_{CO} = 2.5\text{ V}$, $C1(2) = 1.3\text{ V}$ | 12 | 20 | 28 | μA |
| RTC1(2) | C1 (C2) Charge/Discharge Current Ratio | $RTC1(2) = IC1(2)+ / IC1(2)-$ | 0.8 | 1.0 | 1.2 | |
| RTCCHG | C1/C2 Charge Current Ratio | $RTCCHG = IC1+ / IC2+$ | 0.8 | 1.0 | 1.2 | |
| RTCDIS | C1/C2 Discharge Current Ratio | $RTCDIS = IC1- / IC2-$ | 0.8 | 1.0 | 1.2 | |
| VCW1(2) | C1 (C2) Cramp Voltage Width | | 1.0 | 1.3 | 1.6 | V |
| VFGL | FG Output Low Level Voltage | $IFG = 3\text{ mA}$ | | | 0.5 | V |
| VRDL | RD Output Low Level Voltage | $IRD = 3\text{ mA}$ | | | 0.5 | V |
| TTSD | Thermal Shut Down Operating Temperature (Note 3) | Junction temperature Design target (Note 4) | 150 | 180 | | $^\circ\text{C}$ |
| ΔTTSD | Thermal Shut Down Hysteresis Temperature (Note 3) | Junction temperature Design target (Note 4) | | 15 | | $^\circ\text{C}$ |

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.

3. The thermal shut down circuit is built-in for protection from damage of IC. But its operation is out of T_{opr} . Design thermal calculation at normal operation.

4. Design target value and no measurement is made.

5. The I_O is a peak value of motor-current.

LB11685AV

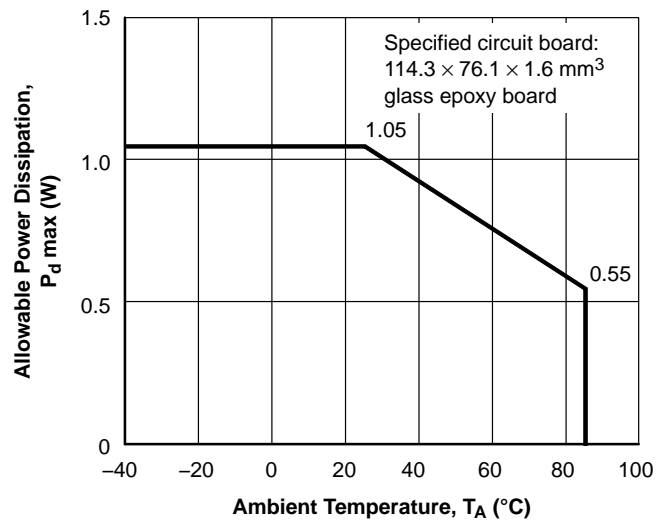


Figure 1. $P_d \text{ max} - T_A$

LB11685AV

BLOCK DIAGRAM

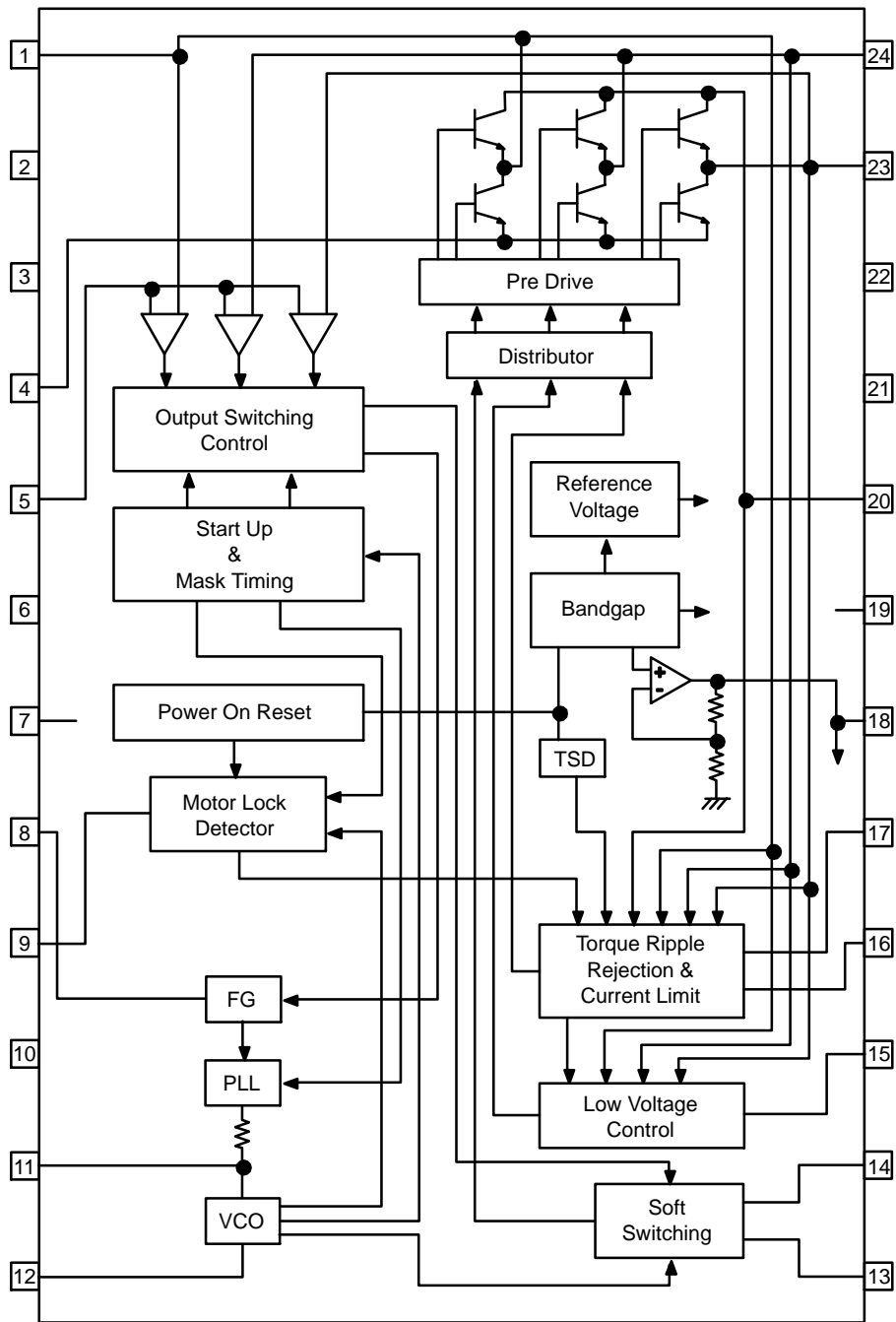


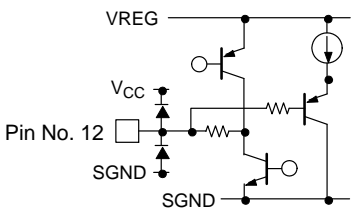
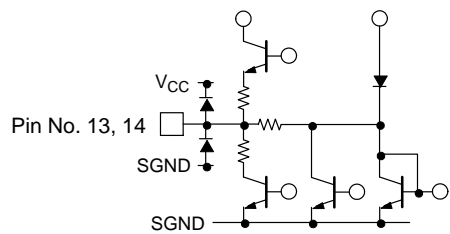
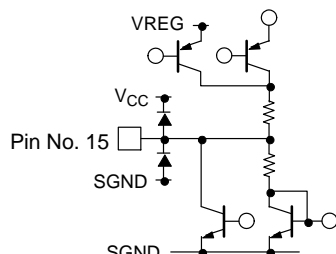
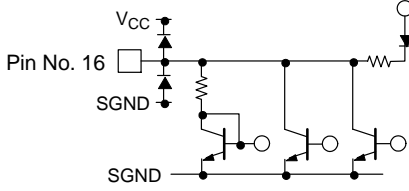
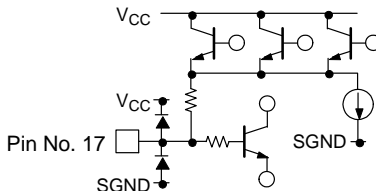
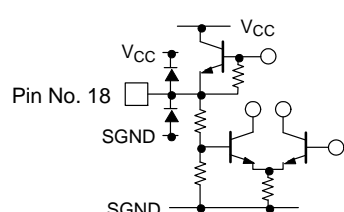
Figure 2. Block Diagram

PIN FUNCTION

PIN FUNCTION

| Pin No. | Pin Name | Function | Equivalent Circuit |
|---------------|----------------------|--|--------------------|
| 1 23 24 | UOUT WOUT VOUT | Each output pin of three phases. | |
| 4 | PGND | GND pin in the output part. This pin is connected to GND. The SGND pin is also connected to GND | |
| 20 | RF | Pin to detect output current. By connecting a resistor between this pin and V_{CC} , the output current is detected as a voltage. The current limiter is operated by this voltage. | |
| 5 | MCOM | Motor coil midpoint input pin. The coil voltage waveform is detected based on this voltage. | |
| 7 | SGND | Ground pin (except the output part) This pin is connected to GND. The PGND pin is also connected to GND. | |
| 8 | FG | FG out made by back EMF pin. It synchronizes FG out with inverted V-phase. When don't use this function, open this pin. | |
| 9 | RD | Motor lock protection detection output pin. Output with L during rotation of motor. Open during lock protection of motor (High-impedance). When don't use this function, open this pin. | |
| 11 | VCO | PLL output pin and VCO input pin. To stabilize PLL output, connect a capacitor between this pin and GND. | |

PIN FUNCTION (continued)

| Pin No. | Pin Name | Function | Equivalent Circuit |
|----------|----------|--|---|
| 12 | CX | VCO oscillation output pin. Operation frequency range and minimum frequency are determined by the capacity of the capacitor connected to this pin. |  |
| 13 14 | C1 C2 | Soft switching adjustment pin. The triangular wave from is form formed by connecting a capacitor with this pin. And, the switching of three-phase output is adjusted by the slope. |  |
| 15 | FC2 | Frequency characteristic correction pin 2. To suppress the oscillation of control system closed loop of sink-side, connect a capacitor between this pin and GND. |  |
| 16 | FC1 | Frequency characteristic correction pin 1. To suppress the oscillation of control system closed loop of source-side, connect a capacitor between this pin and GND. |  |
| 17 | VOH | Three-phase output high level output pin. To stabilize the output voltage of this pin, connect a capacitor between this pin and the VCC pin. |  |
| 18 | VREG | DC voltage (3.3 V) output pin. Connect a capacitor between this pin and GND for stabilization. |  |
| 19 | VCC | Pin to supply power-supply voltage. To curb the influence of ripple and noise. The voltage should be stabilized. | |

LB11685AV

APPLICATION CIRCUIT EXAMPLE

* Each fixed number in the following Figure 3, is the referential value.

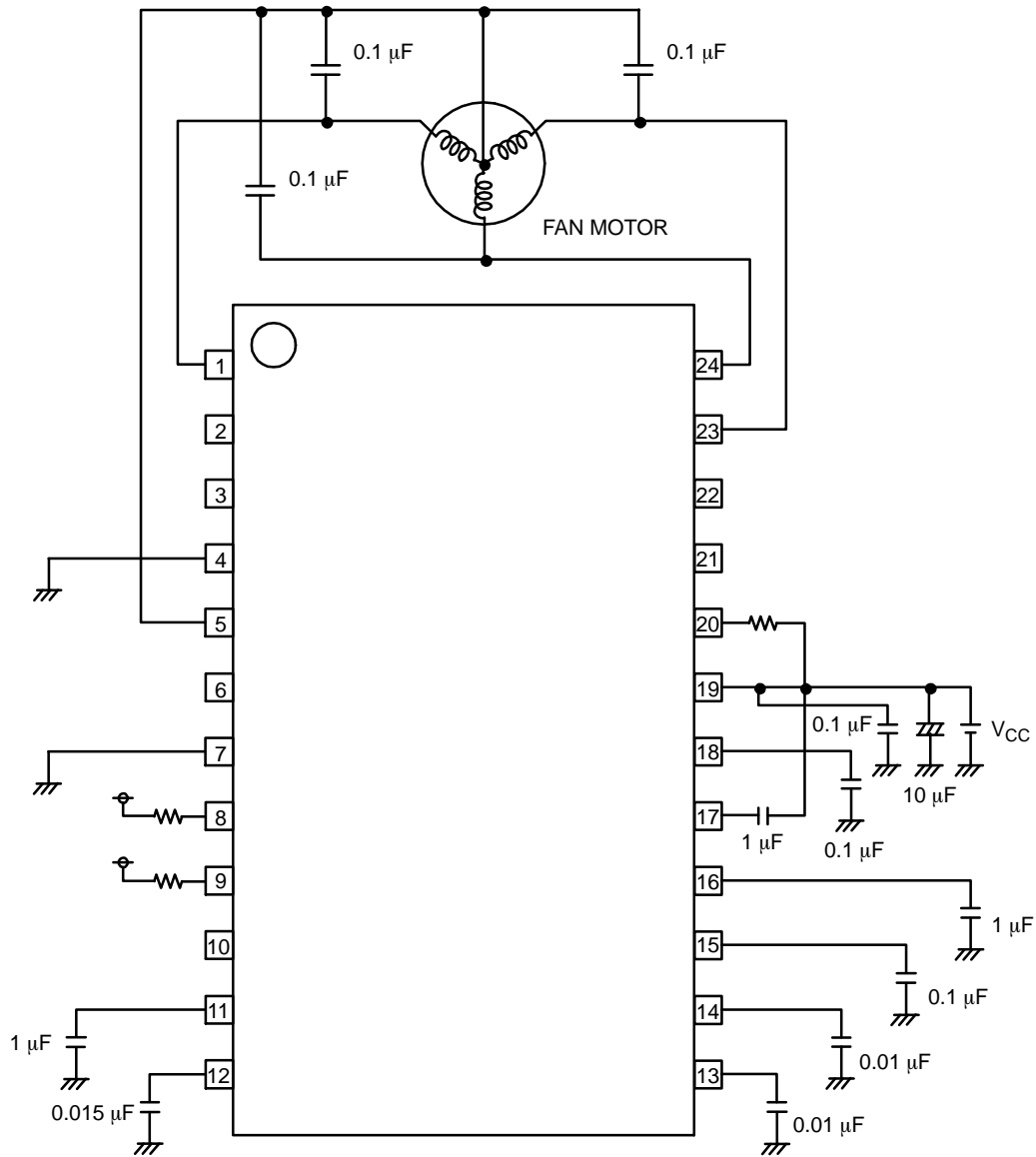


Figure 3. Application Circuit Example

ORDERING INFORMATION

| Device | Package | Wire Bond | Shipping [†] (Qty / Packing) |
|-----------------|--|-----------|---------------------------------------|
| LB11685AV-TLM-H | SSOP24J (275mil) (Pb-Free / Halogen Free) | Au-wire | 2000 / Tape & Reel |
| LB11685AV-W-AH | SSOP24J (275mil) (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](#).

MECHANICAL CASE OUTLINE

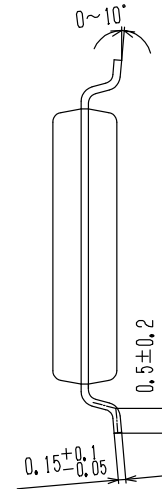
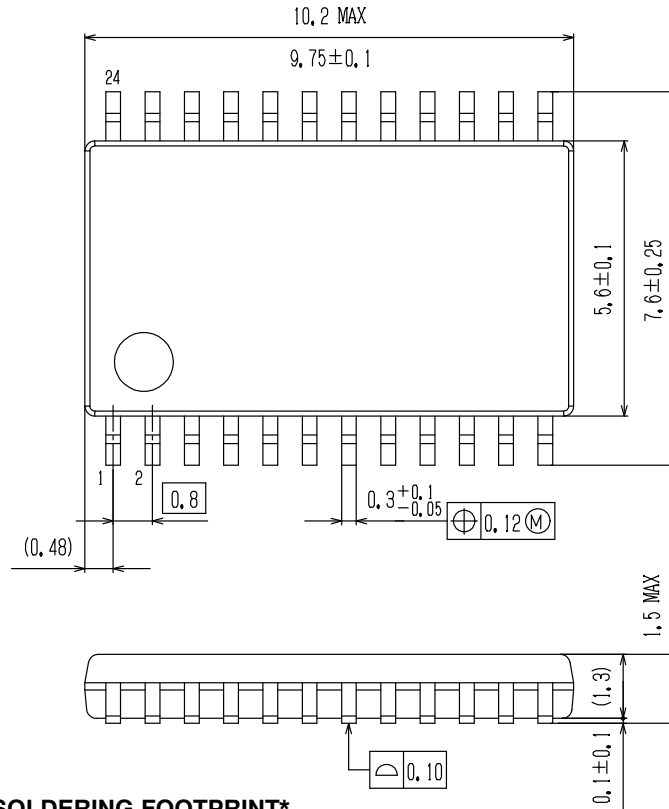
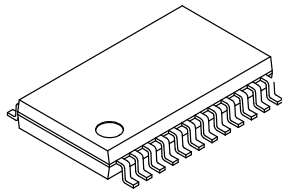
PACKAGE DIMENSIONS

ON Semiconductor®

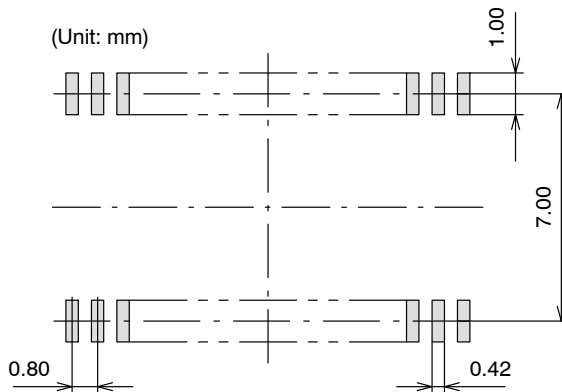
ON

SSOP24J (275mil)
CASE 565AS
ISSUE A

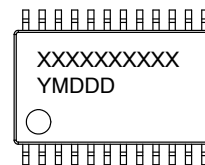
DATE 31 OCT 2013



SOLDERING FOOTPRINT*



GENERIC MARKING DIAGRAM*



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

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.

*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.

| | | |
|-------------------------|-------------------------|--|
| DOCUMENT NUMBER: | 98AON66070E | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red. |
| DESCRIPTION: | SSOP24J (275MIL) | PAGE 1 OF 1 |

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** 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 **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** 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. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** 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 **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** 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 **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Email Requests to: orderlit@onsemi.com

onsemi Website: www.onsemi.com

TECHNICAL SUPPORT

North American Technical Support:

Voice Mail: 1 800-282-9855 Toll Free USA/Canada

Phone: 011 421 33 790 2910

Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative