# ON Semiconductor

# Is Now

**To learn more about onsemi™, please visit our website at**
**www.onsemi.com**

**onsemi** and 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** 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. Other names and brands may be claimed as the property of others.

Downloaded from Arrow.com.

FAIRCHILD™

**Is Now Part of**

ON Semiconductor®

**To learn more about ON Semiconductor, please visit our website at**
**www.onsemi.com**

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (_), the underscore (_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at www.onsemi.com. Please email any questions regarding the system integration to Fairchild_questions@onsemi.com.

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.

Downloaded from Arrow.com.

April 2015

# FAN25800
# 500 mA, Low-$I_Q$, Low-Noise, LDO Regulator

## Features

- $V_{IN}$: 2.3 V to 5.5 V
- $V_{OUT}$ = 2.7 V, 3.3 V ($I_{OUT}$ Max. = 500 mA)
- $V_{OUT}$ = 2.8 V ($I_{OUT}$ Max. = 250 mA)
- Output Noise Density at 250 mA and 10 kHz = 19 nV/√Hz (Integrated 8 µVrms)
- Low $I_Q$ of 17 µA in Regulation and Low-$I_Q$ Dropout Mode with Optimized Dropout Transitions
- <70 mV Dropout Voltage at 250 mA Load
- Controlled Soft-Start to Reduce Inrush Current
- Thermal Shutdown Protection (TSD)
- Input Under-Voltage Lockout (UVLO)
- Short-Circuit Protection (SCP)
- Stable with Two 1.5 µF, 0201 Ceramic Capacitors at VOUT
- 4-Ball WLCSP, 0.65 mm x 0.65 mm, 0.35 mm Pitch, Plated Solder, 330 µm Maximum Thickness

## Applications

- WiFi Modules
- PDA Handsets
- Smart Phones, Tablets, Portable Devices

## Description

The FAN25800 is a linear low-dropout regulator with a high PSRR (85 dB at 100 Hz) and low output noise (typically 8 $\mu V_{RMS}$ over a 10 Hz to 100 kHz bandwidth). The LDO can provide up to 500 mA of output current.

The enable control pin can be used to shut down the device and disconnect the output load from the input. During shutdown, the supply current drops below 1 µA.

The FAN25800 is designed to be stable with space-saving ceramic capacitors as small as 0201 case size. The FAN25800 is available in a 4-bump, 0.35 mm pitch, WLCSP package.

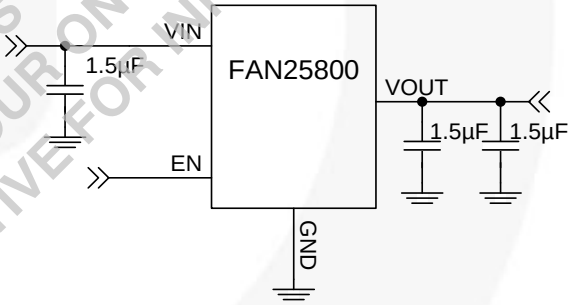



**Figure 1. Typical Application**

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION

## Ordering Information

| Part Number[1] | $V_{OUT}$ | $I_{OUT_MAX}$ | Operating Temperature | Package | Packing Method |
|---|---|---|---|---|---|
| FAN25800AUC33X | 3.3 V | 500 mA | -40°C to 85°C | 4-Bump, WLCSP, 0.65 x 0.65 mm, 0.35 mm Pitch | Tape & Reel |
| FAN25800AUC28X | 2.8 V | 250 mA | | | |
| FAN25800AUCF27X | 2.7 V | 500 mA | | | |

**Note:**
1. For other trim options, please contact a Fairchild representative.

© 2014 Fairchild Semiconductor Corporation


Downloaded from Arrow.com.

## Block Diagram

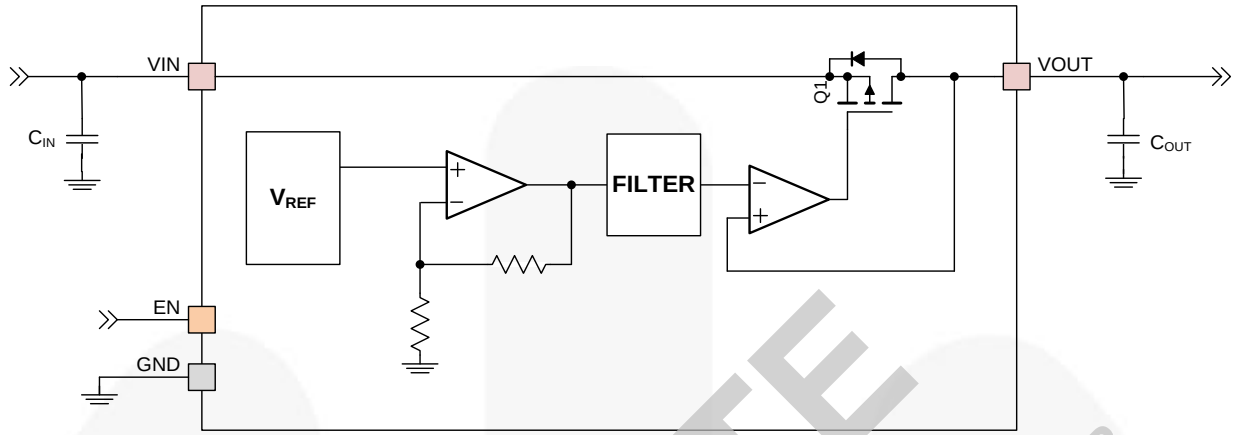



**Figure 2. IC and System Block Diagram**

**Table 1. Recommended External Components**

| Component | Description | Vendor | Parameter | Typ. | Unit |
|---|---|---|---|---|---|
| $C_{IN}$ | 1.5 µF, 6.3 V, X5R, 0201 | Murata GRM033R60J155M | C | 1.5[2] | µF |
| $C_{OUT}$ | 2x1.5 µF, 6.3 V, X5R, 0201 | Murata GRM033R60J155M | | 1.5[2] | µF |
| $C_{Alternative}$[3] | 1.0 µF, 6.3 V, X5R, 0201 | Murata GRM033R60J105M | | 1.0[2] | µF |

**Notes:**

2. Capacitance value does not reflect effects of bias, tolerance, and temperature. *See Recommended Operating Conditions and Operation Description sections for more information.*
3. $C_{Alternative}$ can be used for both $C_{IN}$ and $C_{OUT}$. FAN25800 is stable with one 1 µF at $C_{IN}$ and one 1 µF at $C_{OUT}$.

## Pin Configuration

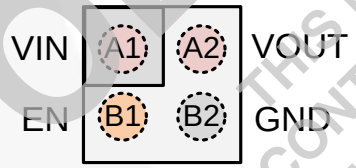



**Figure 3. Top-Through View**

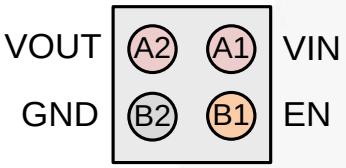



**Figure 4. Bottom View**

## Pin Definitions

| Pin # | Name | Description |
|---|---|---|
| A1 | VIN | **Input Voltage**. Connect to input power source and $C_{IN}$. |
| A2 | VOUT | **Output Voltage**. Connect to $C_{OUT}$ and load. |
| B1 | EN | **Enable**. The device is in Shutdown Mode when this pin is LOW. No internal pull-down. Do not leave this pin floating. Recommended to not tie EN pin directly to VIN.[4] |
| B2 | GND | **Ground**. Power and IC ground. All signals are referenced to this pin. |

**Note:**

4. Recommended to use logic voltage of 1.8 V to drive the EN pin.

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol | Parameter | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{IN}$ | Input Voltage with Respect to GND | | -0.3 | 6.0 | V |
| $V_{CC}$ | Voltage on Any Other Pin (with Respect to GND) | | -0.3 | $V_{IN}$+0.3[5] | V |
| $T_J$ | Junction Temperature | | -40 | +150 | °C |
| $T_{STG}$ | Storage Temperature | | -65 | +150 | °C |
| $T_L$ | Lead Soldering Temperature, 10 Seconds | | | +260 | °C |
| ESD | Electrostatic Discharge Protection Level | Human Body Model, ANSI/ESDA/JEDEC JS-001-2012 | 4000 | | V |
| | | Charged Device Model per JESD22-C101 | 1500 | | |
| LU | Latch Up | | JESD 78D | | |

**Note:**

5. Lesser of 6.0 V or $V_{IN}$ + 0.3 V.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{IN}$ | Supply Voltage | 2.3 | | 5.5[6] | V |
| $I_{OUT_MAX}$[7] | Output Current ($V_{OUT}$ = 2.7 V, 3.3 V) | | | 500 | mA |
| $I_{OUT_Recommend}$ | Output Current ($V_{OUT}$ = 3.3 V) | | | 500 | mA |
| | Output Current ($V_{OUT}$ = 2.7 V, 2.8 V) | | | 250 | mA |
| $C_{IN}$ | Input Capacitor (Effective Capacitance)[8] | 0.4 | 0.8 | | µF |
| $C_{OUT}$ | Output Capacitor (Effective Capacitance)[8] | 0.4 | 0.8 | 15.0 | µF |
| $T_A$ | Ambient Temperature | –40 | | +85 | °C |
| $T_J$ | Junction Temperature | –40 | | +125 | °C |

**Note:**

6. For $V_{IN}$ ≥ 3.4 V, thermal properties of the device must be taken into account at maximum load of 500 mA; refer to $\theta_{JA}$ thermal properties.
7. $I_{OUT_MAX}$ is for $V_{IN}$ = $V_{OUT}$ + 0.3 V.
8. Effective capacitance, including the effects of bias, tolerance, and temperature. *See the Operation Description section for more information.*

## Thermal Properties

Junction-to-ambient thermal resistance is a function of application and board layout. This data is measured with four-layer 2s2p boards in accordance to JEDEC standard JESD51. Special attention must be paid not to exceed junction temperature, $T_{J(max)}$, at a given ambient temperature, $T_A$.

| Symbol | Parameter | Typ. | Unit |
|---|---|---|---|
| $\theta_{JA}$ | Junction-to-Ambient Thermal Resistance | 180 | °C/W |

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

## Electrical Specifications

Minimum and maximum values are at $V_{IN} = V_{OUT} + 0.3$ V; $T_A$ = -40°C to +85°C; and test circuit shown in Figure 1. Typical values are at $V_{IN} = V_{OUT} + 0.3$ V, $T_A$ = 25°C, $I_{LOAD}$ = 10 mA, and $V_{EN}$ = 1.8 V, unless otherwise noted.

| Symbol | Parameter | Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **LDO** | | | | | | | |
| $I_{IN}$ | $V_{IN}$ Supply Current | $V_{IN} = V_{OUT} + 0.3$ V to 4.2 V, $I_{LOAD}$ = 0 mA | | | 17.0 | 25.0 | µA |
| | | Dropout[10], $I_{LOAD}$ = 0 mA | | | 18.5 | 30.0 | |
| PSRR | Power Supply Rejection Ratio[9] | $I_{OUT}$ = 10 mA, $V_{IN}$ = 3.6 V, $V_{OUT}$ = 3.3 V | f = 50 Hz | | 84 | | dB |
| | | | f = 100 Hz | | 85 | | |
| | | | f = 1 kHz | | 84 | | |
| | | | f = 10 kHz | | 79 | | |
| | | $I_{OUT}$ = 250 mA, $V_{IN}$ = 3.6 V, $V_{OUT}$ = 3.3 V | f = 50 Hz | | 68 | | |
| | | | f = 100 Hz | | 73 | | |
| | | | f = 1 kHz | | 75 | | |
| | | | f = 10 kHz | | 76 | | |
| $e_n$ | Output Noise Voltage Density[9] | f = 10 kHz, $V_{OUT}$ = 3.3 V | $I_{OUT}$ = 10 mA | | 20 | 40 | nV/√Hz |
| | | | $I_{OUT}$ = 250 mA | | 19 | 39 | |
| $e_{n_bw}$ | Output Noise Voltage (Integrated)[9] | f = 10 Hz – 100 kHz, $V_{OUT}$ = 3.3 V | $I_{OUT}$ = 10 mA | | 8 | 25 | $µV_{RMS}$ |
| | | | $I_{OUT}$ = 250 mA | | 8 | 25 | |
| $V_{DO}$ | $V_{OUT}$ Dropout Voltage[10] | $V_{OUT} = V_{OUT_TARGET}$ – 100 mV, $I_{OUT}$ = 250 mA | | | 70 | 130 | mV |
| $\Delta V_{OUT}$ | $V_{OUT}$ Voltage Accuracy | 5 mA ≤ $I_{OUT}$ ≤ $I_{OUT_Recommend}$, $V_{IN} = V_{OUT} + 0.3$ V to 4.2 V | | -1.9 | | +1.9 | % |
| $\Delta V_{OUT_LOAD}$ | Load Regulation | $I_{OUT}$ = 5 mA to $I_{OUT_MAX}$ | | | 12 | 35 | µV/mA |
| $I_{LIM}$ | $V_{OUT}$ Current Limit | $I_{OUT}$ = 0 mA → Current Limit, $V_{OUT}$ = 3.3 V, 2.7V, $V_{OUT}$ Drops by 2% | | 550 | 650 | 800 | mA |
| | | $I_{OUT}$ = 0 mA → Current Limit, $V_{OUT}$ = 2.8 V, $V_{OUT}$ Drops by 2% | | 275 | 323 | 400 | |
| $I_{SD}$ | Shutdown Supply Current | $V_{EN}$ = 0 V, $V_{IN} = V_{OUT} + 0.3$ V to 4.2 V | | | 0.125 | 1.000 | µA |
| $V_{UVLO}$ | Under-Voltage Lockout Threshold | Rising $V_{IN}$ | | | 2.1 | 2.3 | V |
| $V_{UVHYS}$ | Under-Voltage Lockout Hysteresis | | | | 150 | | mV |
| $t_{START}$ | Startup Time | Rising EN to 95% $V_{OUT}$, $I_{OUT}$ = 10 mA | | | 250 | 500 | µs |
| TSD | Thermal Shutdown | Rising Temperature | | | 150 | | °C |
| | | Hysteresis | | | 20 | | |
| **Logic Levels: EN** | | | | | | | |
| $V_{IH}$ | Enable High-Level Input Voltage | | | 1.05 | | | V |
| $V_{IL}$ | Enable Low-Level Input Voltage | | | | | 0.4 | V |
| $I_{EN}$ | Input Bias Current | $V_{EN}$ = 1.8 V | | | 0.04 | 1.00 | µA |

**Notes:**

9. Guaranteed by design; not tested in production.
10. Dropout voltage = $V_{IN}$ - $V_{OUTx}$ when $V_{OUT}$ drops more than 100 mV below the nominal regulated $V_{OUT}$ level.

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

## Typical Characteristics

Unless otherwise specified; $V_{IN}$ = 3.6 V, $V_{OUT}$ = 3.3 V, $T_A$ = +25°C, and test circuit per Figure 1.

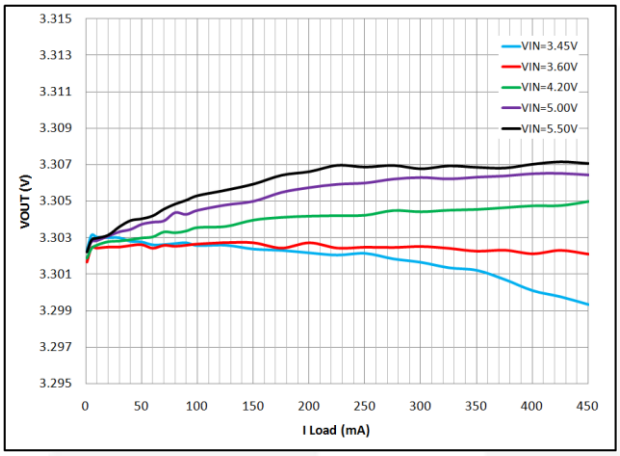



**Figure 5. Output Regulation vs. Load Current and Input Voltage**

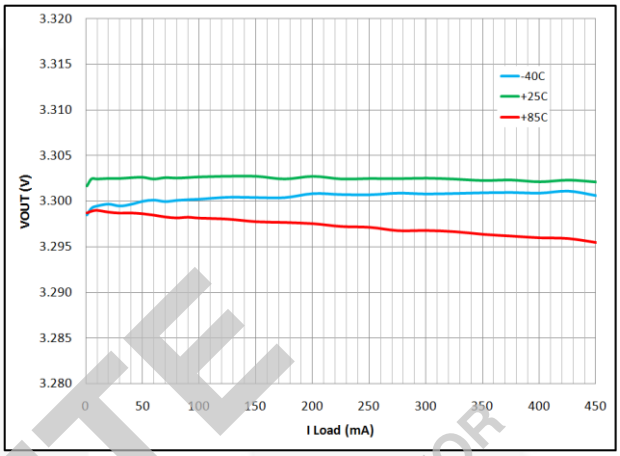



**Figure 6 Output Regulation vs. Load Current and Temperature**

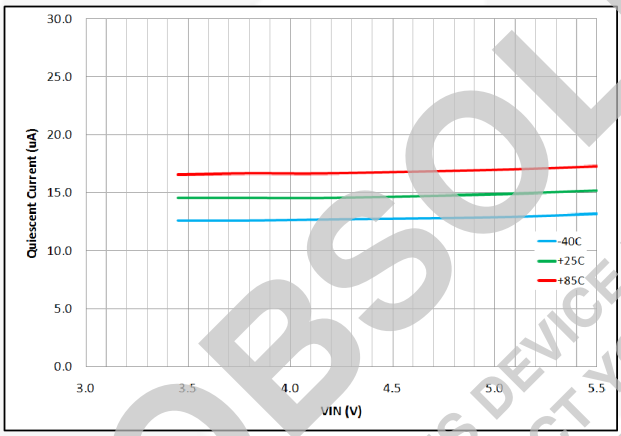



**Figure 7. Quiescent Current vs. Input Voltage and Temperature**

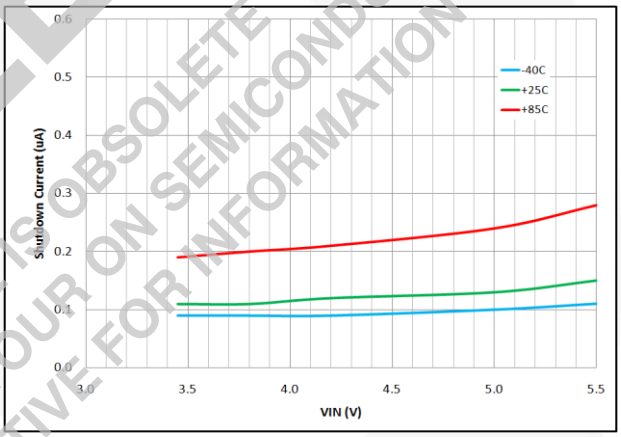



**Figure 8. Shutdown Current vs. Input Voltage and Temperature**

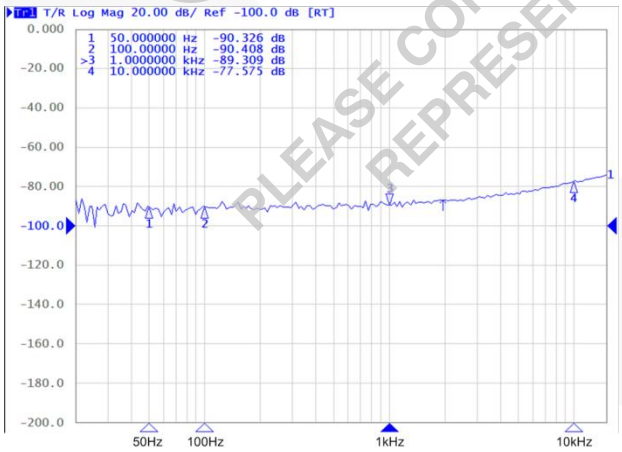



**Figure 9. PSRR vs. Frequency, 10 mA Load**

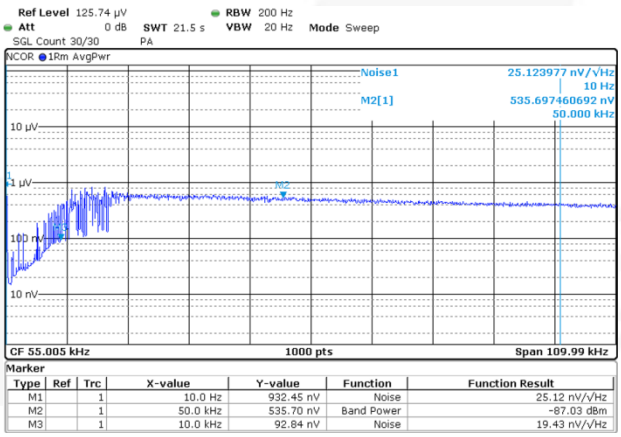



**Figure 10. Output Noise Voltage vs. Frequency, 10 mA Load**

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

## Typical Characteristics

Unless otherwise specified; $V_{IN}$ = 3.6 V, $V_{OUT}$ = 3.3 V, $T_A$ = +25°C, and test circuit per Figure 1.

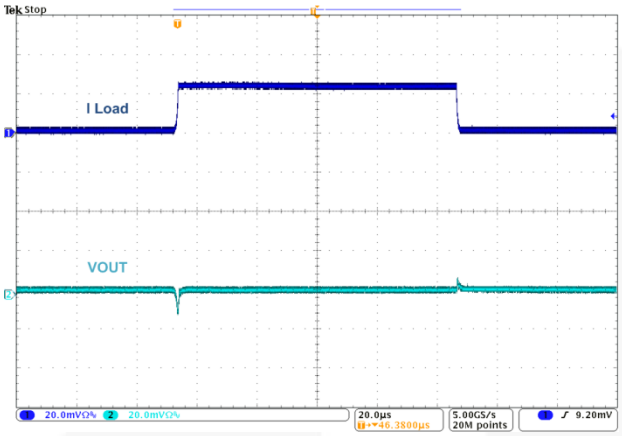



**Figure 11. Load Transient, $I_{OUT}$ = 10 → 250 → 10 mA, $V_{IN}$=3.6 V, 400 ns Edge**

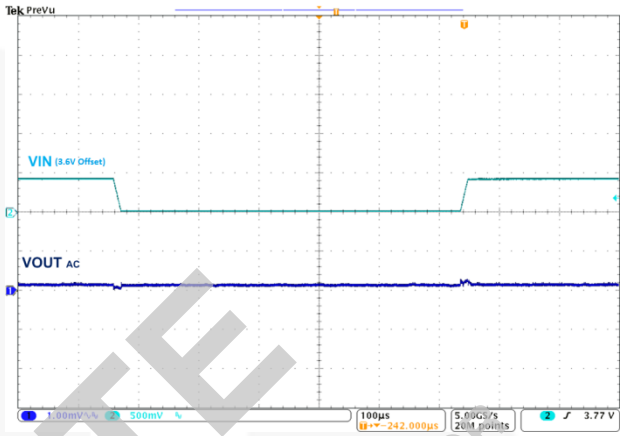



**Figure 12. Line Transient, $V_{IN}$ = 4.0 → 3.6 → 4.0 V, 10 µs Transitions, 10 mA Load**

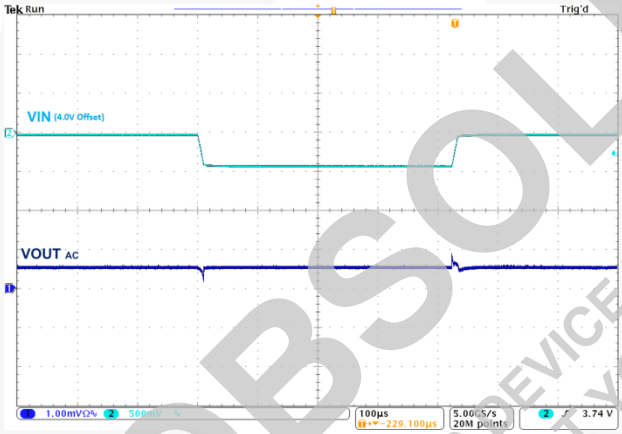



**Figure 13. Line Transient, $V_{IN}$ = 4.0 → 3.6 → 4.0 V, 10 µs Transitions, 250 mA Load**

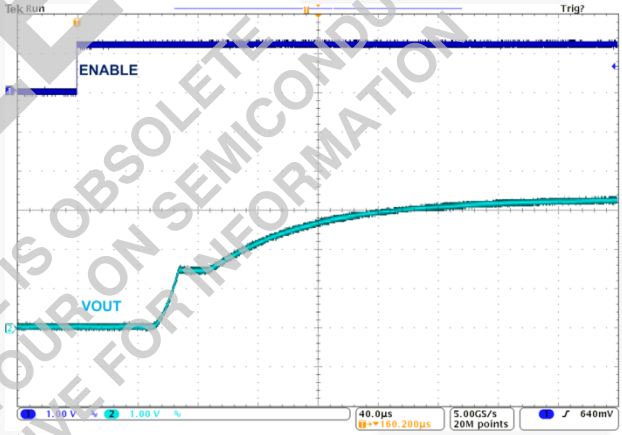



**Figure 14. Startup, 10 mA Load**

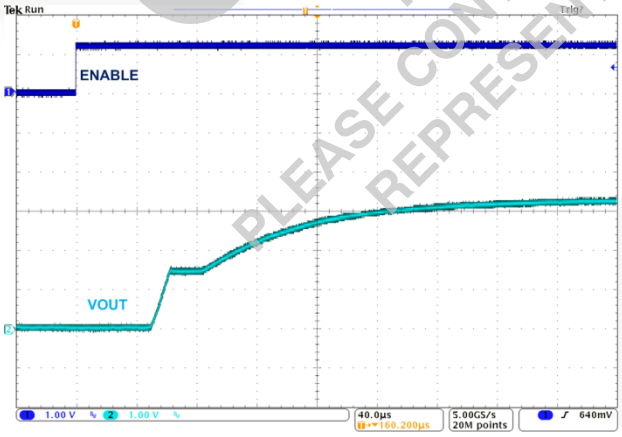



**Figure 15. Startup, 250 mA Load**

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

## Circuit Description

The FAN25800 is a linear low-dropout (LDO) regulator that has high PSRR and low output noise. The enable control pin can be used to shut down the device and disconnect the output load from the input. During shutdown, the supply current drops below 1 µA. The LDO is designed to be stable with space-saving ceramic capacitors as small as 0201 case size.

### Enable and Soft-Start

When EN is LOW, all circuits are off and the IC draws <550 nA of current. The EN pin does not have an internal pull-down resistor and must not be left floating. When EN is HIGH and $V_{IN}$ is above the UVLO threshold, the regulator begins a soft-start cycle for the output. The soft-start cycle controls inrush current, limiting it to the $I_{LIM}$ peak current limit.

### Short-Circuit and Thermal Protection

The output current is short-circuit protected. When an output fault occurs, the output current is automatically limited to $I_{LIM}$ and $V_{OUT}$ drops. The resultant $V_{OUT}$ is equal to $I_{LIM}$ multiplied by the fault impedance.

Short-circuit fault or output overload may cause the die temperature to increase and exceed the maximum rating due to power dissipation. In such cases (depending upon the ambient temperature; the $V_{IN}$, load current, and thermal resistance ($\theta_{JB}$) of the mounted die), the device may enter thermal shutdown.

If the die temperature exceeds the thermal shutdown temperature threshold, the onboard thermal protection disables the output until the temperature drops below its hysteresis value. At that point, the output is re-enabled and a new soft-start sequence occurs.

### Thermal Considerations

For best performance, the die temperature and the power dissipated should be kept at moderate values. The maximum power dissipated can be evaluated based on the following relationship:

$$P_{D(max)} = \left\{ \frac{T_{J(max)} - T_A}{\Theta_{JA}} \right\} \quad (1)$$

where $T_{J(max)}$ is the maximum allowable junction temperature of the die; $T_A$ is the ambient operating temperature; and $\theta_{JA}$ is dependent on the surrounding PCB layout and can be improved by providing a heat sink of surrounding copper ground.

The addition of backside copper with through-holes, stiffeners, and other enhancements can help reduce $\theta_{JA}$. The heat contributed by the dissipation of devices nearby must be included in design considerations.

### Capacitor Selection

An output capacitor with an effective capacitance between 400 nF and 15 µF is required for loop stability. The ESR value should be within 3 to 100 mΩ. DC bias characteristics of the capacitors must be considered when selecting the voltage rating and the case size of the capacitor. Figure 16 is a typical derating curve for a 0201 case size, 1.5 µF, 6.3 V, X5R capacitor.

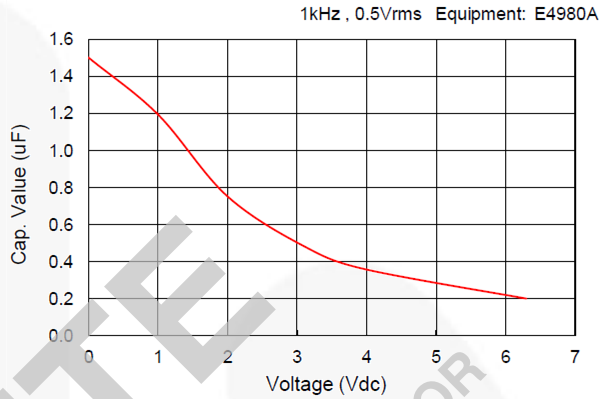



**Figure 16. Capacitor DC Bias Characteristics**

### Typical Application for Post Regulation

Due to its high PSRR and low output noise, the FAN25800 can be used as a post-DC-DC regulator to reduce output ripple and output noise at high efficiency for noise-sensitive applications. Figure 17 shows a post-DC-DC regulation of the LDO with a buck converter. The capacitor on the output of the buck converter can be shared by the LDO as its input capacitor.

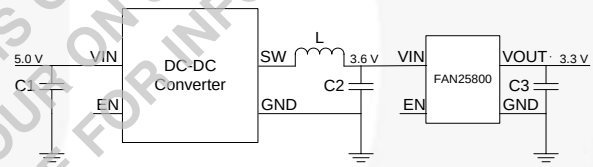



**Figure 17. LDO as Post DC-DC Regulator**

### PCB Layout Recommendations

Capacitors should be placed as close to the IC as possible. All power and ground pins should be routed to their capacitors using top copper. The copper area connecting to the IC should be maximized to improve thermal performance.

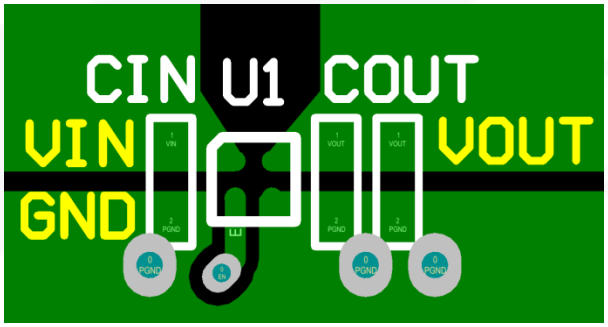



**Figure 18. Recommended Layout**

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

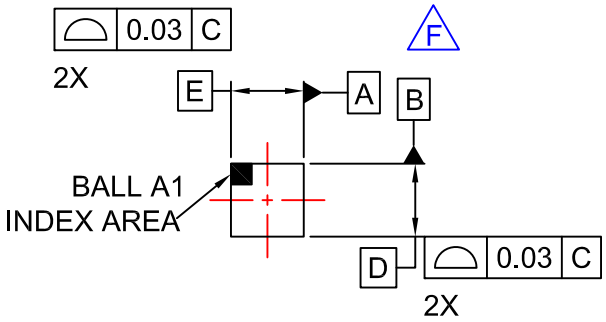
## Product-Specific Dimensions

| D | E | X | Y |
|---|---|---|---|
| 0.65 ±0.025 mm | 0.65 ±0.025 mm | 0.15 mm | 0.15 mm |

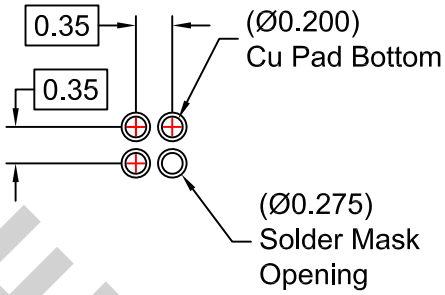
OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION



Downloaded from Arrow.com.

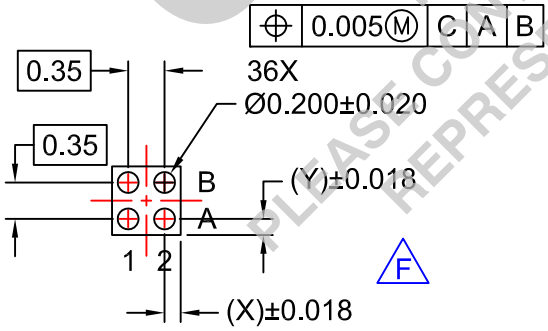



TOP VIEW




RECOMMENDED LAND PATTERN
(NSMD TYPE)

SIDE VIEWS




BOTTOM VIEW

NOTES

A. NO JEDEC REGISTRATION APPLIES.

B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS AND TOLERANCE PER ASME Y14.5M, 2009.

D. DATUM C IS DEFINED BY THE SPHERICAL CROWNS OF THE BALLS.

E. PACKAGE NOMINAL HEIGHT IS 298 ± 32 MICRONS (266-330 MICRONS).

F. FOR DIMENSIONS D,E,X, AND Y SEE PRODUCT DATASHEET.

G. DRAWING FILNAME: MKT-UC004AK REV1

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION

Downloaded from Arrow.com.

OBSOLETE
THIS DEVICE IS OBSOLETE
PLEASE CONTACT YOUR ON SEMICONDUCTOR
REPRESENTATIVE FOR INFORMATION

ON Semiconductor and ON 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.

## PUBLICATION ORDERING INFORMATION

**LITERATURE FULFILLMENT**:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
**Phone**: 303−675−2175 or 800−344−3860 Toll Free USA/Canada
**Fax**: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
**Email**: orderlit@onsemi.com

**N. American Technical Support**: 800−282−9855 Toll Free USA/Canada
**Europe, Middle East and Africa Technical Support:**
Phone: 421 33 790 2910
**Japan Customer Focus Center**
Phone: 81−3−5817−1050

**ON Semiconductor Website**: **www.onsemi.com**

**Order Literature**: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative



Downloaded from Arrow.com.