



**Is Now Part of**



**ON Semiconductor®**

**To learn more about ON Semiconductor, please visit our website at**  
**[www.onsemi.com](http://www.onsemi.com)**

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](http://www.onsemi.com). Please email any questions regarding the system integration to [Fairchild\\_questions@onsemi.com](mailto: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](http://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.

# FAN7340

## LED Backlight Driving Boost Switch

### Features

- Single-Channel Boost LED Switch
- Internal Power MOSFET for PWM Dimming:  
 $R_{DS(on)} = 3.4 \Omega$  at  $V_{GS}=10\text{ V}$ ,  $BV_{DSS}=400\text{ V}$
- Current Mode PWM Control
- Internal Programmable Slope Compensation
- Wide Supply Voltage Range: 10 V to 35 V
- LED Current Regulation:  $\pm 1\%$
- Programmable Switching Frequency
- Analog and PWM Dimming
- Wide Dimming Ratio: On Time=10  $\mu\text{s}$  to DC
- Cycle-by-Cycle Current Limiting
- Thermal Shutdown: 150°C
- Open-LED Protection (OLP)
- Over-Voltage Protection (OVP)
- Over-Current Protection (OCP)
- Error Flag Generation (for External Load Switch)
- Internal Soft-Start
- 16-Lead SOIC Package

### Applications

- LED Backlight for LCD TV
- LED Backlight for LCD Monitor
- LED Lighting

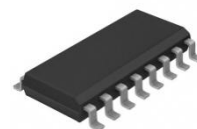
### Description

The FAN7340 is a single-channel boost controller that integrates an N-channel power MOSFET for PWM dimming using Fairchild's proprietary planar Double-diffused MOS (DMOS) technology.

The IC operates as a constant-current source for driving high-current LEDs.

It uses Current Mode control with programmable slope compensation to prevent subharmonic oscillation. The IC provides protections including: open-LED protection, over-voltage protection, and direct-short protection for high system reliability.

The IC internally generates a FAULT signal with delay if an abnormal LED string condition occurs. PWM dimming and analog dimming functions can be implemented independently. Internal soft-start prevents inrush current flowing into output capacitor at startup.



### Ordering Information

| Part Number | Operating Temperature Range | Package                                          | Packaging Method |
|-------------|-----------------------------|--------------------------------------------------|------------------|
| FAN7340MX   | -40°C to +125°C             | 16-Lead, Small-Outline Integrated Circuit (SOIC) | Tape & Reel      |

# Block Diagram

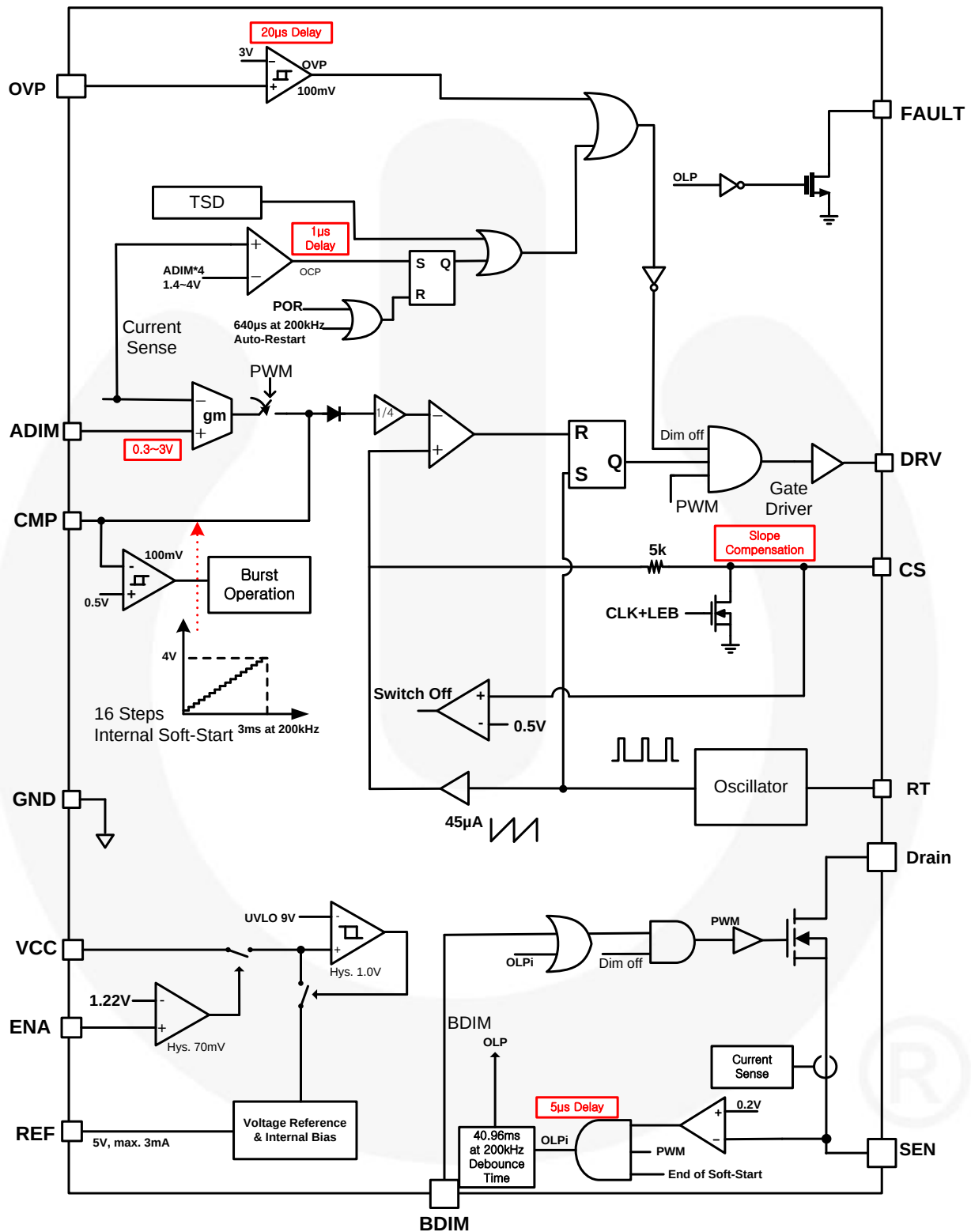


Figure 1. Internal Block Diagram

## Pin Assignments

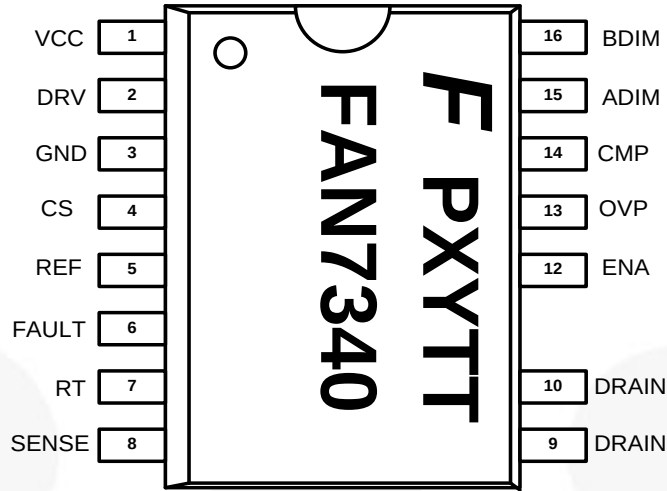


Figure 2. Package Diagram

## Pin Definitions

| Pin # | Name  | Description                                                                                                                                                                                                                                                                                                   |
|-------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | VCC   | This pin is the supply voltage of the IC.                                                                                                                                                                                                                                                                     |
| 2     | DRV   | This pin is the gate drive signal of the boost switch.                                                                                                                                                                                                                                                        |
| 3     | GND   | This pin is the ground of the IC.                                                                                                                                                                                                                                                                             |
| 4     | CS    | This pin is for sensing the current flowing through an external MOSFET. It includes a built-in 300 ns blanking time. The peak of the current flowing through the MOSFET is limited to this pin voltage. Slope compensation of the boost controller can be programmed through the series resistor of this pin. |
| 5     | REF   | This pin is the 5 V reference voltage pin. Maximum current capability is 3 mA.                                                                                                                                                                                                                                |
| 6     | FAULT | This pin is for indicating the fault signal. This pin is connected to the open drain. When OLP protection is occurred, the FAULT pin is pulled HIGH.                                                                                                                                                          |
| 7     | RT    | Oscillator frequency set of the boost switch (50 kHz ~ 300 kHz).                                                                                                                                                                                                                                              |
| 8     | SENSE | This pin is for sensing the current flowing through the LEDs. A sensing resistor is connected from this pin to ground. This pin is connected to the negative input of the internal error amplifier.                                                                                                           |
| 9, 10 | DRAIN | Drain pin of PWM dimming power MOSFET.                                                                                                                                                                                                                                                                        |
| 12    | ENA   | Enable input pin. If voltage of this pin is higher than 1.22 V, IC is starting to operate. If the voltage of this pin is lower than 1.15 V, the IC stops operating.                                                                                                                                           |
| 13    | OVP   | Over-voltage protection input pin. Output voltage of the boost circuit is connected to this pin through a resistor divider circuit. If this pin voltage is higher than 3 V, OVP is triggered.                                                                                                                 |
| 14    | CMP   | This pin is the error amplifier output. Typically, a compensation capacitor and resistor are connected to this pin from the ground.                                                                                                                                                                           |
| 15    | ADIM  | This pin is for setting the current flowing through the LEDs. This pin is connected to the positive inputs of the internal error amplifier. Linear voltage range of ADIM is 0.3 V~3.0 V.                                                                                                                      |
| 16    | BDIM  | This pin is for the burst dimming signal. If this pin voltage is HIGH, the internal dimming MOSFET is turned on. If this pin voltage is LOW, the dimming MOSFET is turned off.                                                                                                                                |

### Note:

- Pin 11 is a "No Connect" pin (not shown in Figure 2).

## 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.  $T_A=25^{\circ}\text{C}$  unless otherwise specified.

| Symbol        | Parameter                                               | Min. | Max. | Unit                 |
|---------------|---------------------------------------------------------|------|------|----------------------|
| $V_{CC}$      | Supply Voltage                                          | 10   | 35   | V                    |
| $T_A$         | Operating Temperature Range                             | -40  | +125 | $^{\circ}\text{C}$   |
| $T_J$         | Junction Temperature                                    |      | +150 | $^{\circ}\text{C}$   |
| $T_{STG}$     | Storage Temperature Range                               | -65  | +150 | $^{\circ}\text{C}$   |
| $\Theta_{JA}$ | Thermal Resistance Junction-to-Ambient <sup>(2,3)</sup> |      | 120  | $^{\circ}\text{C/W}$ |
| $P_D$         | Power Dissipation                                       |      | 0.9  | W                    |

### Notes:

- Thermal resistance test board; size 76.2 mm x 114.3 mm x 1.6 mm (1S0P); JEDEC standard: JESD51-2, JESD51-3.
- Assume no ambient airflow.

## Pin Breakdown Voltage

| Pin # | Name  | Value | Unit |
|-------|-------|-------|------|
| 1     | VCC   | 35    | V    |
| 2     | DRV   | 20    | V    |
| 3     | GND   |       | V    |
| 4     | CS    | 6     | V    |
| 5     | REF   | 6     | V    |
| 6     | FAULT | 35    | V    |
| 7     | RT    | 6     | V    |
| 8     | SENSE | 6     | V    |

| Pin # | Name  | Value | Unit |
|-------|-------|-------|------|
| 9     | DRAIN | 400   | V    |
| 10    | DRAIN | 400   | V    |
| 11    | N/A   |       | V    |
| 12    | ENA   | 6     | V    |
| 13    | OVP   | 6     | V    |
| 14    | CMP   | 6     | V    |
| 15    | ADIM  | 6     | V    |
| 16    | BDIM  | 6     | V    |

## Electrical Characteristics

For typical values,  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 15\text{ V}$  unless otherwise specified. Specifications to  $-40^\circ\text{C} \sim 125^\circ\text{C}$  are guaranteed by design based on final characterization results.

| Symbol                               | Parameter                                       | Condition                                                     | Min. | Typ. | Max. | Unit            |
|--------------------------------------|-------------------------------------------------|---------------------------------------------------------------|------|------|------|-----------------|
| <b>Supply Voltage Section</b>        |                                                 |                                                               |      |      |      |                 |
| $V_{CC}$                             | Input DC Supply Voltage Range <sup>(4)</sup>    |                                                               | 10   |      | 35   | V               |
| $I_{SD}$                             | Shutdown Mode Supply Current                    | BDIM Connected to GND                                         |      | 2    | 4    | mA              |
| <b>Under-Voltage Lockout Section</b> |                                                 |                                                               |      |      |      |                 |
| $V_{th}$                             | Start Threshold Voltage                         |                                                               | 8.3  | 9.0  | 9.7  | V               |
| $V_{th,hys}$                         | Start Threshold Voltage Hysteresis              |                                                               | 0.5  | 1.0  | 1.5  | V               |
| $I_{st}$                             | Standby Current                                 | $V_{CC}=V_{th}-0.2$                                           |      | 200  | 300  | $\mu\text{A}$   |
| <b>ON/OFF Section</b>                |                                                 |                                                               |      |      |      |                 |
| $V_{on}$                             | On-State Input Voltage                          |                                                               | 2    |      | 5    | V               |
| $V_{off}$                            | Off-State Input Voltage                         |                                                               |      |      | 0.8  | V               |
| <b>Error Amplifier Section</b>       |                                                 |                                                               |      |      |      |                 |
| $G_m$                                | Error Amplifier Transconductance <sup>(4)</sup> | $V_{ADIM}=1\text{ V}$                                         | 100  | 300  | 500  | $\mu\text{mho}$ |
| $A_{v,ro}$                           | Error Amplifier Output impedance <sup>(4)</sup> |                                                               |      | 20   |      | M $\Omega$      |
| $A_v$                                | Error Amplifier Open-Loop Gain <sup>(4)</sup>   |                                                               |      | 60   |      | dB              |
| $V_{offset}$                         | Input Offset Voltage                            | $V_{ADIM}=1\text{ V}$                                         | -10  |      | 10   | mV              |
| $I_{sin}$                            | CMP Sink Current                                | $V_{ADIM}=1\text{ V}$ , $V_{SENSE}=2\text{ V}$                | 100  | 200  | 300  | $\mu\text{A}$   |
| $I_{sur}$                            | CMP Source Current                              | $V_{ADIM}=1\text{ V}$ , $V_{SENSE}=0\text{ V}$                | 100  | 200  | 300  | $\mu\text{A}$   |
| $V_{IDR}$                            | Input Differential Voltage Range                |                                                               | 0    |      | 3    | V               |
| $V_o$                                | Output Voltage Range                            |                                                               | 0.7  |      | 4.0  | V               |
| <b>Oscillator Section</b>            |                                                 |                                                               |      |      |      |                 |
| $f_{osc}$                            | Boost Oscillator Frequency                      | Min.                                                          |      | 50   |      | kHz             |
|                                      |                                                 | $R_T=100\text{ k}\Omega$                                      | 190  | 200  | 210  | kHz             |
|                                      |                                                 | Max.                                                          |      | 300  |      | kHz             |
| $D_{max}$                            | Maximum Duty Cycle <sup>(4)</sup>               |                                                               | 86   | 90   | 94   | %               |
| <b>Reference Section</b>             |                                                 |                                                               |      |      |      |                 |
| $V_{REF}$                            | 5V Regulation Voltage                           |                                                               | 4.9  | 5.0  | 5.1  | V               |
| $V_{REF,Line}$                       | 5V Line Regulation                              |                                                               |      |      | 25   | mV              |
| $V_{REF,Load}$                       | 5V Load Regulation                              | $0<I_5<3\text{ mA}$                                           |      |      | 25   | mV              |
| <b>PWM Dimming Section</b>           |                                                 |                                                               |      |      |      |                 |
| $V_{PDIM,L}$                         | PWM Dimming Input Low Voltage                   |                                                               |      |      | 0.8  | V               |
| $V_{PDIM,H}$                         | PWM Dimming Input High Voltage                  |                                                               | 2    |      | 5    | V               |
| $R_{PDIM}$                           | PWM Dimming Pull-Down Resistance                |                                                               | 100  | 160  | 220  | k $\Omega$      |
| <b>FET Section (for Dimming)</b>     |                                                 |                                                               |      |      |      |                 |
| $BV_{DSS}$                           | Drain-Source Breakdown Voltage <sup>(4)</sup>   | $V_{CC}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$            | 400  |      |      | V               |
| $I_{DSS}$                            | Zero-Gate-Voltage Drain Current <sup>(4)</sup>  | $V_{DS}=250\text{ V}$ , $T_A=25^\circ\text{C}$                |      | 1    | 30   | $\mu\text{A}$   |
| $R_{DS(ON)}$                         | Drain-Source On-State Resistance                | $V_{GS}=10\text{ V}$ , $I_D=1\text{ A}$                       |      | 3.4  |      | $\Omega$        |
| $C_{ISS}$                            | Input Capacitance <sup>(4)</sup>                | $V_{DS}=25\text{ V}$ , $V_{GS}=0\text{ V}$ , $f=1\text{ MHz}$ |      | 173  | 225  | pF              |
| $C_{OSS}$                            | Output Capacitance <sup>(4)</sup>               | $V_{DS}=25\text{ V}$ , $V_{GS}=0\text{ V}$ , $f=1\text{ MHz}$ |      | 30   | 40   | pF              |

Continued on the following page...

**Electrical Characteristics** (Continued)

For typical values,  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 15\text{ V}$ , unless otherwise specified. Specifications to  $-25^\circ\text{C} \sim 85^\circ\text{C}$  are guaranteed by design based on final characterization results.

| Symbol                                  | Parameter                                                    | Condition                | Min.                | Typ.                  | Max.                | Unit             |
|-----------------------------------------|--------------------------------------------------------------|--------------------------|---------------------|-----------------------|---------------------|------------------|
| <b>Output Section (Boost / Dimming)</b> |                                                              |                          |                     |                       |                     |                  |
| $V_{DRV}$                               | Gate Output Voltage                                          | $V_{CC}=15\text{ V}$     | 10.8                | 11.8                  | 12.8                | V                |
| $V_{UV}$                                | Gate Output Voltage Before Startup                           |                          | -0.5                |                       | 0.5                 | V                |
| $I_{dsur}$                              | Gate Output Drive Source Current <sup>(4)</sup>              |                          | 80                  | 180                   | 280                 | mA               |
| $I_{dsin}$                              | Gate Output Drive Sink Current <sup>(4)</sup>                |                          | 80                  | 180                   | 280                 | mA               |
| $t_{rh}$                                | Gate Output Rising Time (Boost) <sup>(4)</sup>               | $C_L=2.0\text{ nF}$      |                     | 200                   |                     | ns               |
| $t_{fl}$                                | Gate Output Falling Time (Boost) <sup>(4)</sup>              | $C_L=2.0\text{ nF}$      |                     | 120                   |                     | ns               |
| <b>Current Sense Section</b>            |                                                              |                          |                     |                       |                     |                  |
| $t_{blank}$                             | Leading-Edge Blanking <sup>(4)</sup>                         |                          | 150                 | 300                   | 450                 | ns               |
| $t_{delay,cl}$                          | Delay to Output of Current-Limit Comparator <sup>(4)</sup>   |                          |                     |                       | 180                 | ns               |
| $V_{offset,clc}$                        | Offset Voltage of Current-Limit Comparator <sup>(4)</sup>    |                          | -20                 |                       | 20                  | mV               |
| <b>Slope Compensation Section</b>       |                                                              |                          |                     |                       |                     |                  |
| $I_{slope}$                             | Ramp Generator Current                                       |                          | 36                  | 45                    | 54                  | $\mu\text{A}$    |
| $R_{slope}$                             | Slope Compensation Resistor <sup>(4)</sup>                   |                          |                     | 5                     |                     | k $\Omega$       |
| <b>Soft-Start Section</b>               |                                                              |                          |                     |                       |                     |                  |
| $t_{ss}$                                | Soft-Start Period <sup>(4)</sup>                             | $f_{osc}=200\text{ kHz}$ |                     | 3                     |                     | ms               |
| <b>Protection Section</b>               |                                                              |                          |                     |                       |                     |                  |
| $t_{d,ovp,tr}$                          | Delay for Triggering Over-Voltage Protection <sup>(4)</sup>  |                          | 15                  | 20                    | 25                  | $\mu\text{s}$    |
| $t_{d,ovpr}$                            | Delay for Releasing Over-Voltage Protection <sup>(4)</sup>   |                          | 10                  | 14                    | 18                  | $\mu\text{s}$    |
| $t_{d,ocp}$                             | Delay for Over-Current Protection <sup>(4)</sup>             |                          |                     | 1                     |                     | $\mu\text{s}$    |
| $t_{AR}$                                | Auto-Restart Time for Over-Current Protection <sup>(4)</sup> | $f_{osc}=200\text{ kHz}$ |                     | 640                   |                     | $\mu\text{s}$    |
| $t_{d,ol,pi}$                           | Delay for Triggering Open-LED Protection <sup>(4)</sup>      |                          | 3                   | 5                     | 7                   | $\mu\text{s}$    |
| $t_{d,ol,p}$                            | Delay for Open-LED Protection                                | $f_{osc}=200\text{ kHz}$ |                     | 40.96                 |                     | ms               |
| $V_{th,ovp}$                            | Over-Voltage Protection Threshold Voltage                    |                          | 2.85                | 3.00                  | 3.15                | V                |
| $V_{hys,ovp}$                           | Over-Voltage Protection Voltage Hysteresis                   |                          |                     | 0.1                   |                     | V                |
| $V_{th,csocp}$                          | Boost Switch Current Limit Threshold Voltage                 |                          | 0.45                | 0.50                  | 0.55                | V                |
| $V_{th,ocp}$                            | LED Over-Current Protection Threshold Voltage                |                          | 1.4<br>(Min. Clamp) | $4.0 \times V_{ADIM}$ | 4.0<br>(Max. Clamp) | V                |
| $V_{th,ol,p}$                           | Open-LED Protection Threshold Voltage <sup>(4)</sup>         |                          | 0.15                | 0.20                  | 0.25                | V                |
| $T_{SD}$                                | Thermal Shutdown Temperature <sup>(4)</sup>                  |                          | 140                 | 150                   | 160                 | $^\circ\text{C}$ |
| $T_{HYS}$                               | Thermal Shutdown Hysteresis <sup>(4)</sup>                   |                          |                     | 20                    |                     | $^\circ\text{C}$ |

**Notes:**

4. These parameters, although guaranteed, are not tested in production.

## Typical Performance Characteristics

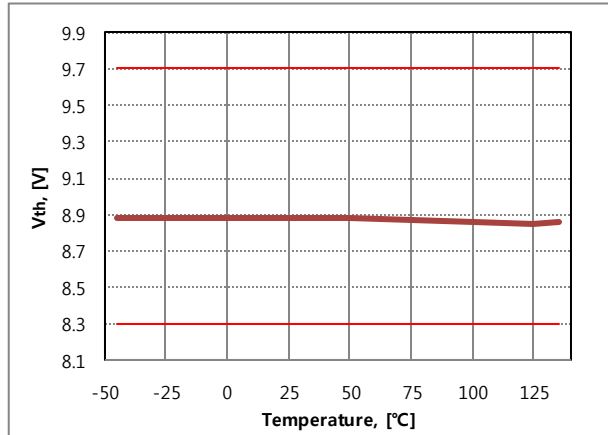


Figure 3. Start Threshold Voltage vs. Temperature

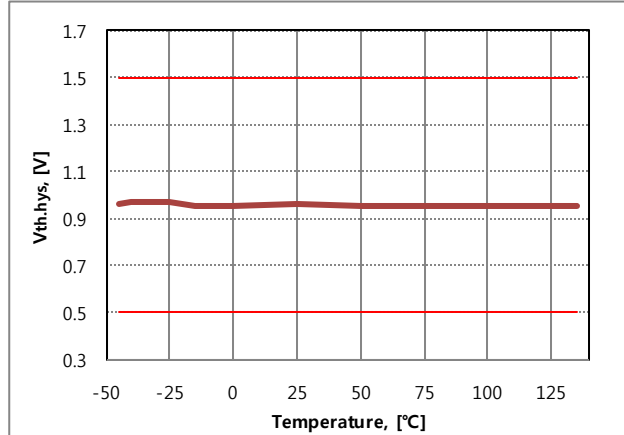


Figure 4. Start Threshold Voltage Hysteresis vs. Temperature

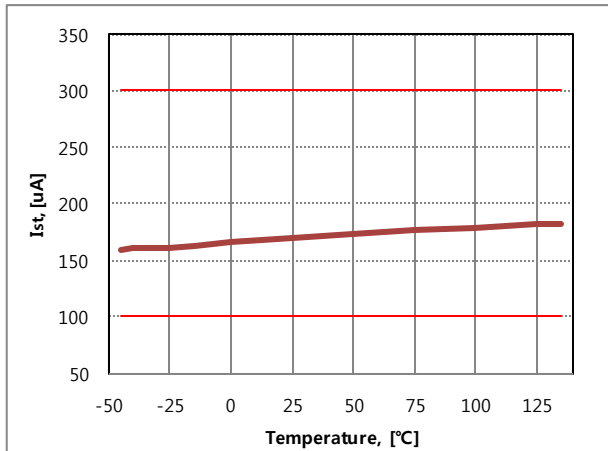


Figure 5. Standby Current vs. Temperature

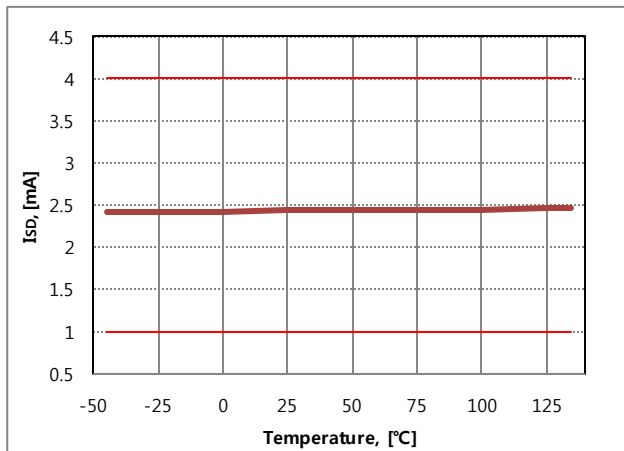


Figure 6. Shutdown Mode Supply Current vs. Temperature

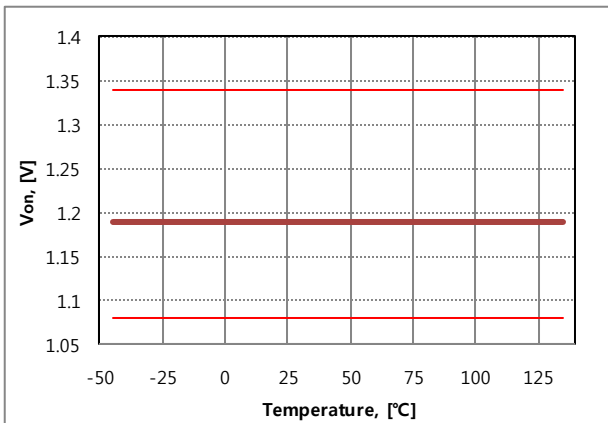


Figure 7. On-State Input Voltage vs. Temperature

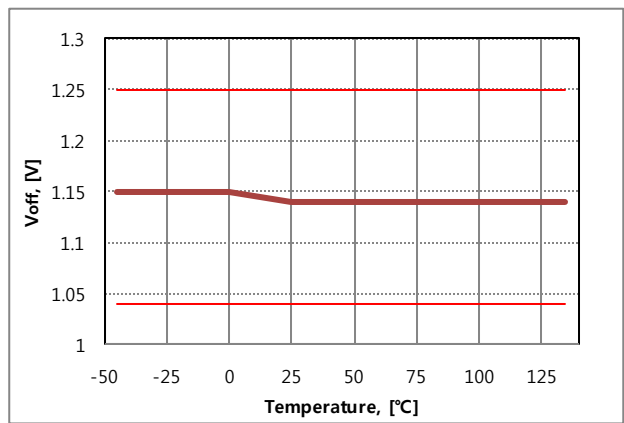


Figure 8. Off-State Input Voltage vs. Temperature



## Typical Performance Characteristics (Continued)

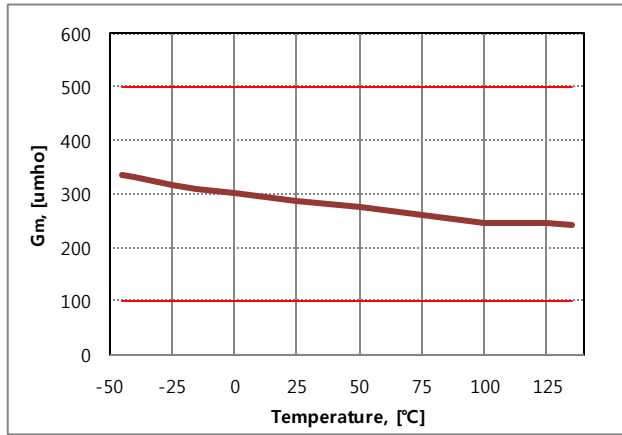


Figure 9. Error Amplifier Transconductance vs. Temperature

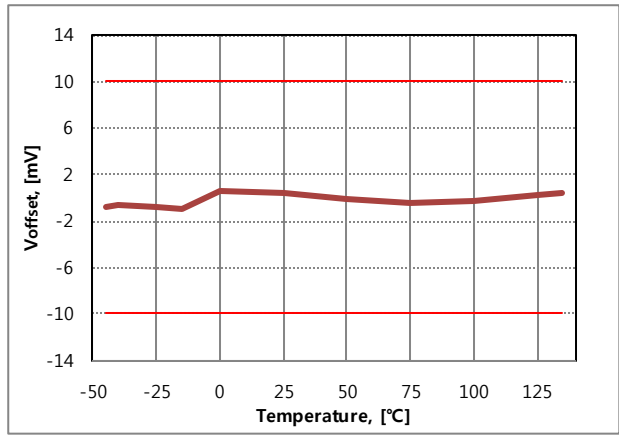


Figure 10. Input Offset Voltage vs. Temperature

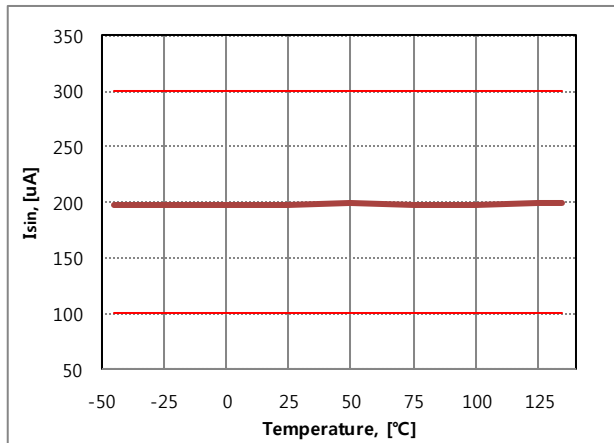


Figure 11. CMP Sink Current vs. Temperature

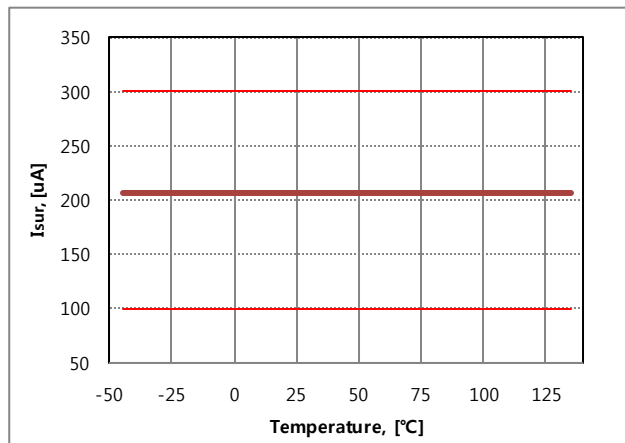


Figure 12. CMP Source Current vs. Temperature

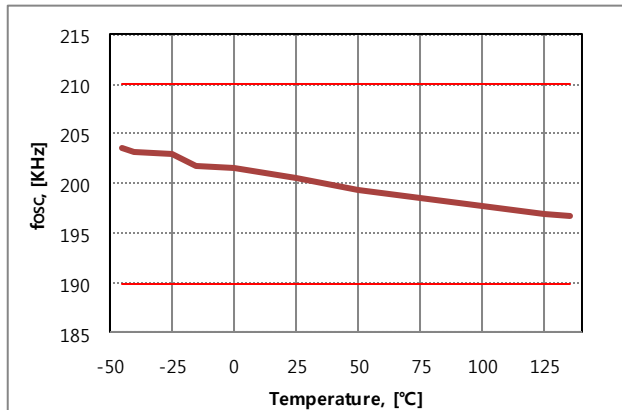


Figure 13. Boost Oscillator Frequency vs. Temperature

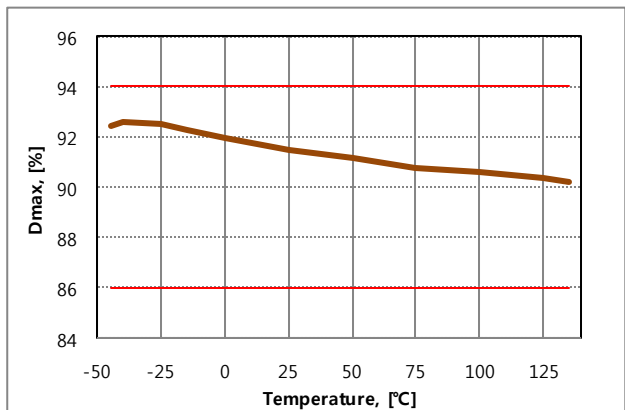


Figure 14. Maximum Duty Cycle vs. Temperature

## Typical Performance Characteristics (Continued)

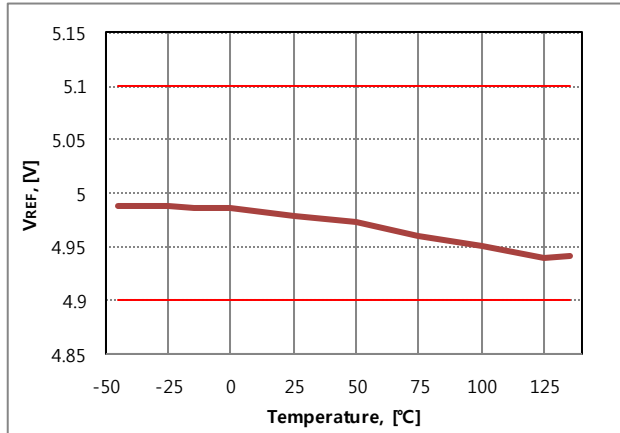


Figure 15. 5V Regulation Voltage vs. Temperature

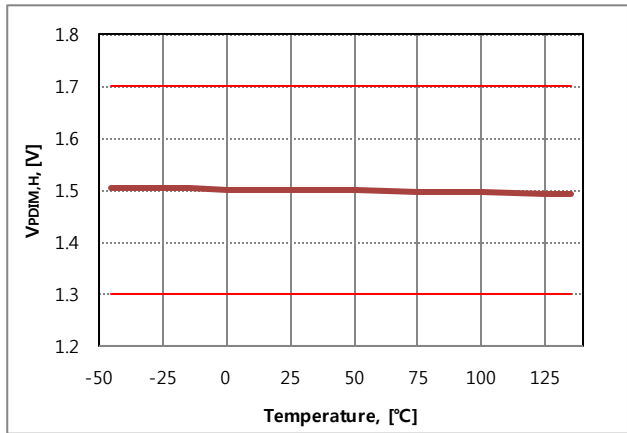


Figure 16. PWM Dimming Input High Voltage vs. Temperature

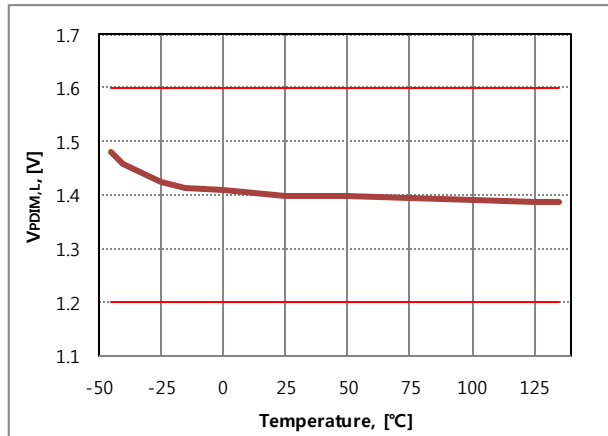


Figure 17. PWM Dimming Input Low Voltage vs. Temperature

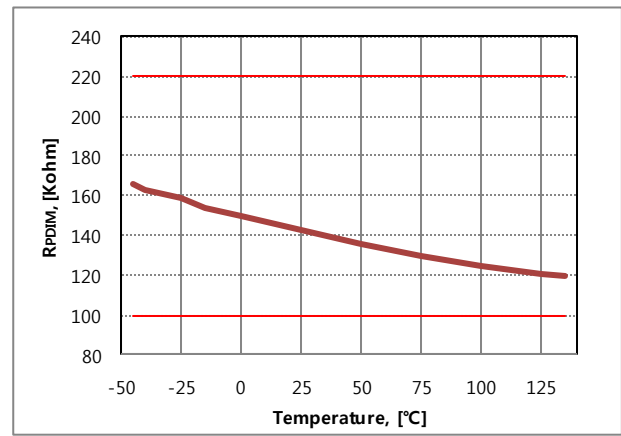


Figure 18. PWM Dimming Pull-Down Resistance vs. Temperature

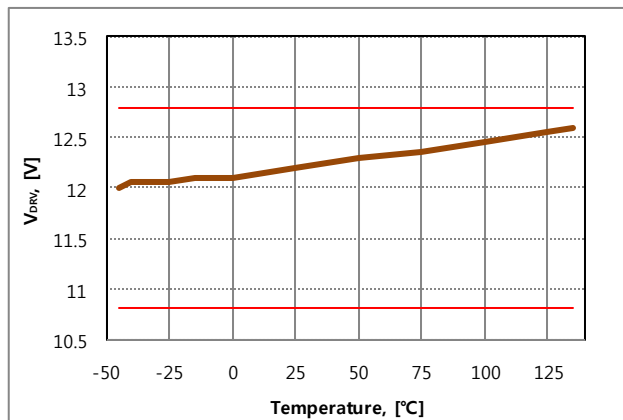


Figure 19. Gate Output Voltage vs. Temperature

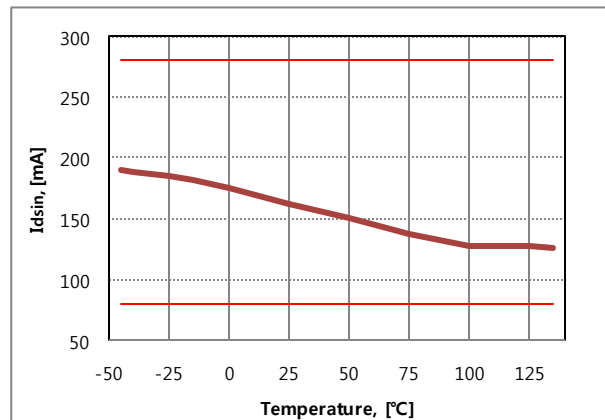


Figure 20. Gate Output Drive Sink Current vs. Temperature

## Typical Performance Characteristics (Continued)

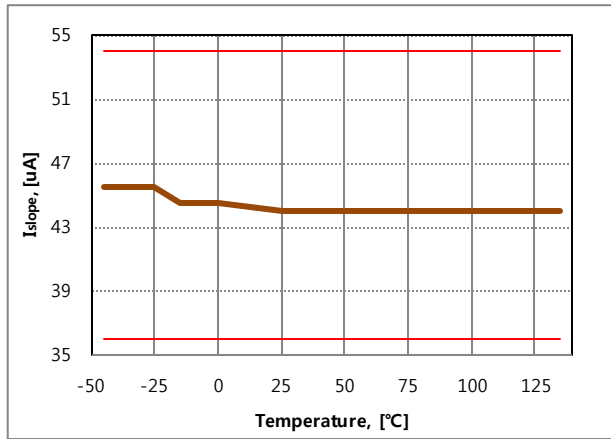


Figure 21. Ramp Generator Current vs. Temperature

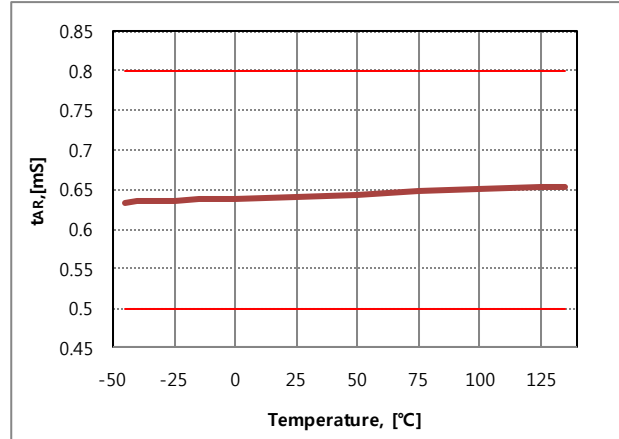


Figure 22. Auto-Restart Time for OCP vs. Temperature

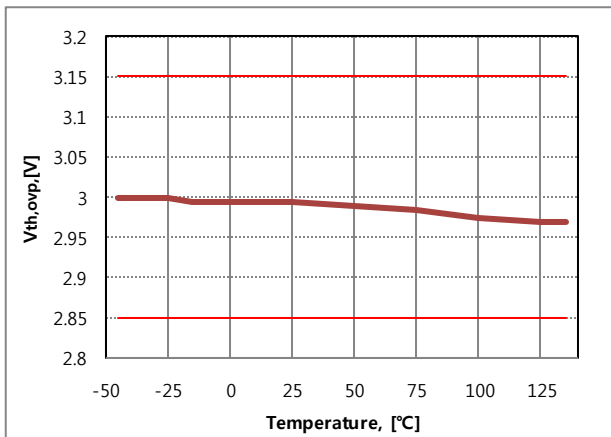


Figure 23. OVP Threshold Voltage vs. Temperature

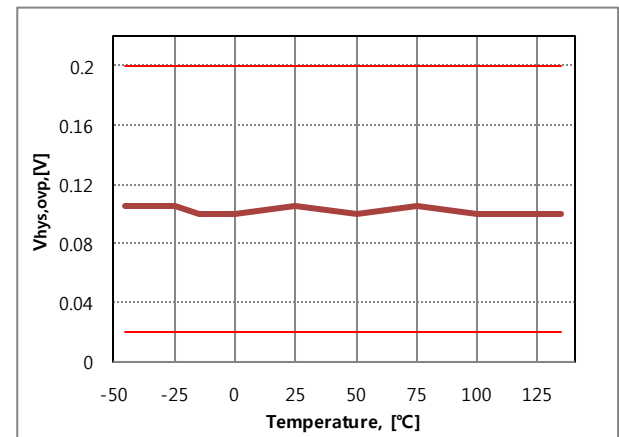


Figure 24. OVP Hysteresis Voltage vs. Temperature

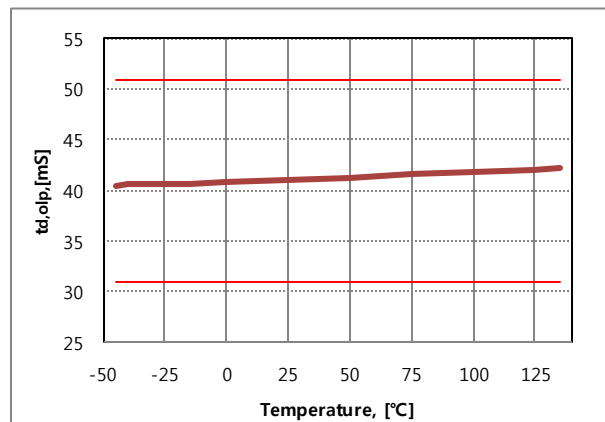


Figure 25. Delay for Over-Current Protection vs. Temperature

## Functional Description

The FAN7340 operates as a constant-current source for driving high-current LEDs. It uses Current-Mode control with programmable slope compensation to prevent sub-harmonic oscillation.

The IC provides protections such as open-LED protection, over-voltage protection, and over-current protection for improved system reliability. The IC internally generates a FAULT OUT signal with a delay in case an abnormal LED string condition occurs. PWM dimming and analog dimming functions can be implemented independently. Internal soft-start prevents inrush current flowing into output capacitor at startup. Circuit operation is explained in the following sections.

### V<sub>CC</sub> Under-Voltage Lockout (UVLO)

An internal regulator provides the regulated 5 V used to power the IC. The Under-Voltage Lockout (UVLO) turns off the IC in the event of the voltage dropping below the specific threshold level. The UVLO circuit inhibits powering the IC until a voltage reference is established, up to predetermined threshold level.

### Enable

Applying voltage higher than 1.22 V (typical) to the ENA pin enables the IC. Applying voltage lower than 1.15 V (typical) to the ENA pin disables the IC. If ENA pin voltage is higher than 1.22 V (typical) and V<sub>CC</sub> is higher than 9.0 V (typical), the IC starts to supply 5 V reference voltage from V<sub>CC</sub>.

### Oscillator (Boost Switching Frequency)

Boost switching frequency is programmed by the value of the resistor connected from the RT pin to ground. RT pin voltage is set to 2 V. The current through the RT pin resistor determines boost switching frequency according to formula:

$$f_{OSC} = \frac{1}{(46.5 \times RT[k\Omega] + 350) \times 10^{-6}} [kHz] \quad (1)$$

### Soft-Start Function at Startup

During initial startup, the switching device can be damaged due to the over-current coming from the input line by the negative control. This can result in the initial overshoot of the LED current. Therefore, during initial startup, the soft-start control gradually increases the duty cycle so that the output voltage can rise smoothly to control inrush current and overshoot.

FAN7340 adapts the soft-start function in the boost converter stage. During soft-start period, boost switch turn-on duty is limited by clamped CMP voltage. The soft-start period is dependent on boost switching frequency, which is decided by the RT resistor (Equation (1)). Soft-start period is set to be cumulative time when the BDIM (PWM dimming) signal is HIGH:

$$T_{SS} = 600 / f_{OSC} [sec] \quad (2)$$

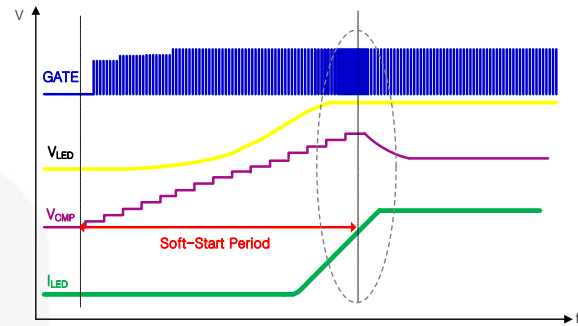


Figure 26. Soft-Start Waveforms

### LED Current Setting

During the boost converter operating periods, the output LED current can be set by equation:

$$I_{LED} = \frac{ADIM(V)}{R_{SENSE} + 60m\Omega} \quad (3)$$

where ADIM(V) is ADIM pin applied voltage and, R<sub>SENSE</sub> is the sensing resistor value. An additional 60 mΩ comes from an internal wire bonding resistor. To calculate LED current precisely, consider the wire bonding resistor.

### Analog Dimming and PWM Dimming

Analog dimming is achieved by varying the voltage level at the ADIM pin. This can be implemented either with a potentiometer from the VREF pin or from an external voltage source and a resistor divider circuit. The ADIM voltage level is adjusted to be the same as the feedback level (V<sub>SENSE</sub>). A V<sub>ADIM</sub> range from 0.3 V to 3 V is recommended.

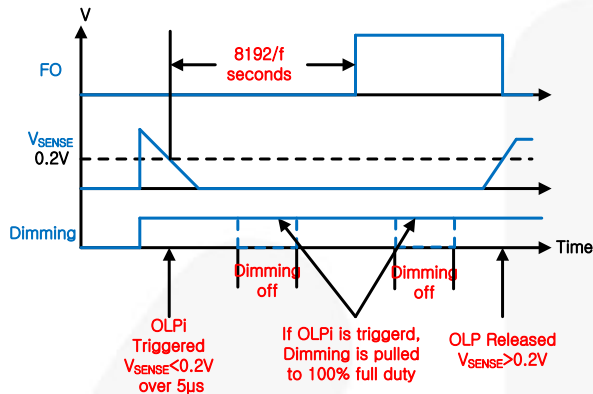
PWM dimming (BDIM) helps achieve a fast PWM dimming response in spite of the shortcomings of the boost converter. The PWM dimming signal controls three nodes in the IC; gate signal to the switching FET, gate signal to the dimming FET, and output connection of the trans-conductance amplifier. When the PWM dimming signal is HIGH, the gates of the switching FET and dimming FET are enabled. At the same time, the output of the transconductance ap-amp is connected to the compensation network. This allows the boost converter to operate normally.

### Dynamic Contrast Ratio

The Dynamic Contrast Ratio (DCR) means the maximum contrast ratio achievable by adjusting the amount of light (dimming) of the screen instantaneously using the backlight during the extremely short period of time. FAN7340 can normally drive the LED backlight under 0.1% dimming duty cycle at 200 Hz dimming frequency. Even operating at 5 μs-dimming FET turn-on time and extremely low dimming duty, FAN7340 can operate LEDs with normal peak current level.



In system operation, OLP is triggered in only direct-short condition. Direct short means that some point of the LED string is shorted to set ground. In direct-short condition, the boost controller cannot control the LED current and a large current flows into the LED string directly from input power. To prevent this abnormal condition, the FO signal is used to turn off input power or the total system. FO signal is only triggered in OLP condition.

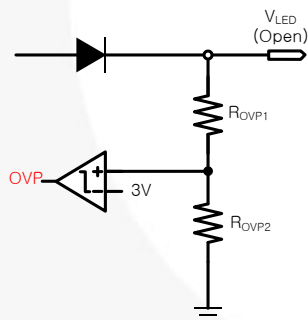


**Figure 29. Open-LED Protection**

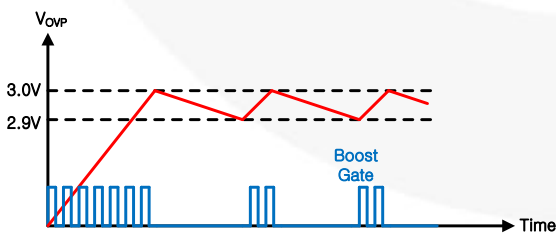
In LED open load condition, OVP is triggered ahead of OLP.

### Over-Voltage Protection (OVP)

Over-voltage protection is triggered when the voltage of the external output voltage trip point meets 3 V. After triggering OVP, the dimming switch and boost switch are turned off. The protection signal is recovered when the output voltage divider is below 2.9 V.



**Figure 30. Over-Voltage Trip Point**



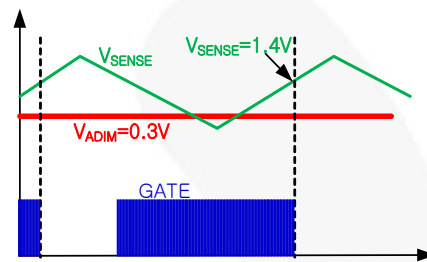
**Figure 31. OVP Trigger and Release**

### LED Over-Current Protection (OCP)

The primary purpose of the over-current protection function is to protect the internal dimming MOSFET from excessive current. The OCP is triggered when the feedback voltage meets the clamping level (1.4 V ~ 4 V) of the ADIM voltage x4. At 1 µs delay after the OCP is triggered, the IC turns off both the boost FET and dimming FET and restarts the gate signal every  $t_{AR}$  automatically.  $t_{AR}$  can be calculated as:

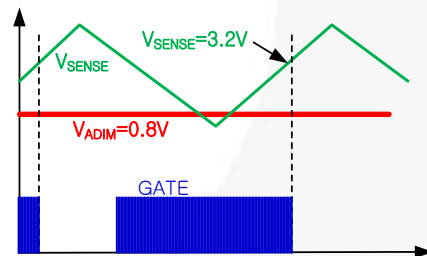
$$t_{AR} = 128 / f_{OSC} [\text{sec}] \quad (7)$$

1. When  $V_{ADIM}=0.3 \text{ V}$  ( $V_{ADIM} \times 4=1.2 \text{ V}$ ).
2. OCP threshold level is set to 1.4 V.
3. OCP is triggered at feedback voltage level = 1.4 V.



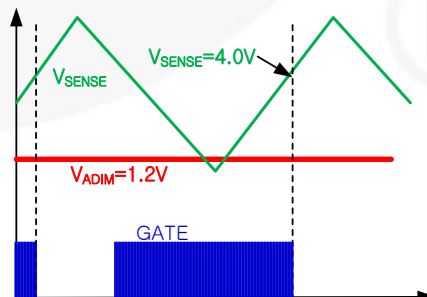
**Figure 32. OCP Waveforms at  $V_{ADIM}=0.3 \text{ V}$**

1. When  $V_{ADIM}=0.8 \text{ V}$  ( $V_{ADIM} \times 4=3.2 \text{ V}$ ).
2. OCP threshold level is set to 3.2 V.
3. OCP is triggered at  $V_{SENSE} = 3.2 \text{ V}$ .



**Figure 33. OCP Waveforms at  $V_{ADIM}=0.8 \text{ V}$**

1. When  $V_{ADIM}=1.2 \text{ V}$  ( $V_{ADIM} \times 4=4.8 \text{ V}$ ).
2. OCP threshold level is set to 4.0 V.
3. OCP is triggered at  $V_{SENSE} = 4.0 \text{ V}$ .



**Figure 34. OCP Waveforms at  $V_{ADIM}=1.2 \text{ V}$**

## Typical Application Circuit (Boost Topology for LED Backlight)

| Application      | Input Voltage Range      | Rated Output Power | Output current (Rated Voltage) | LED              |
|------------------|--------------------------|--------------------|--------------------------------|------------------|
| LED Backlight TV | 120 V <sub>DC</sub> ±10% |                    | 250 mA (230 V)                 | 72-LEDs/1-String |

### Features

- High Efficiency
- Constant Current Boost Converters
- High-Voltage, High-Current LED Driving

### Typical Application Circuit

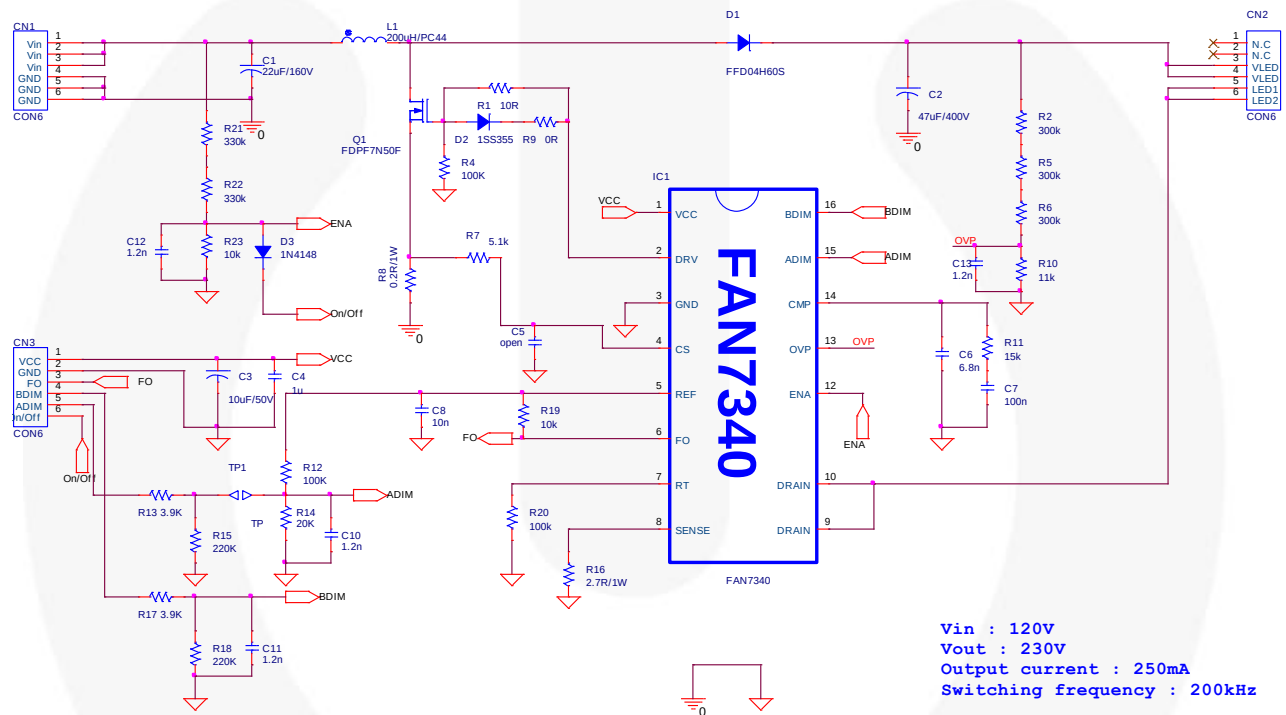
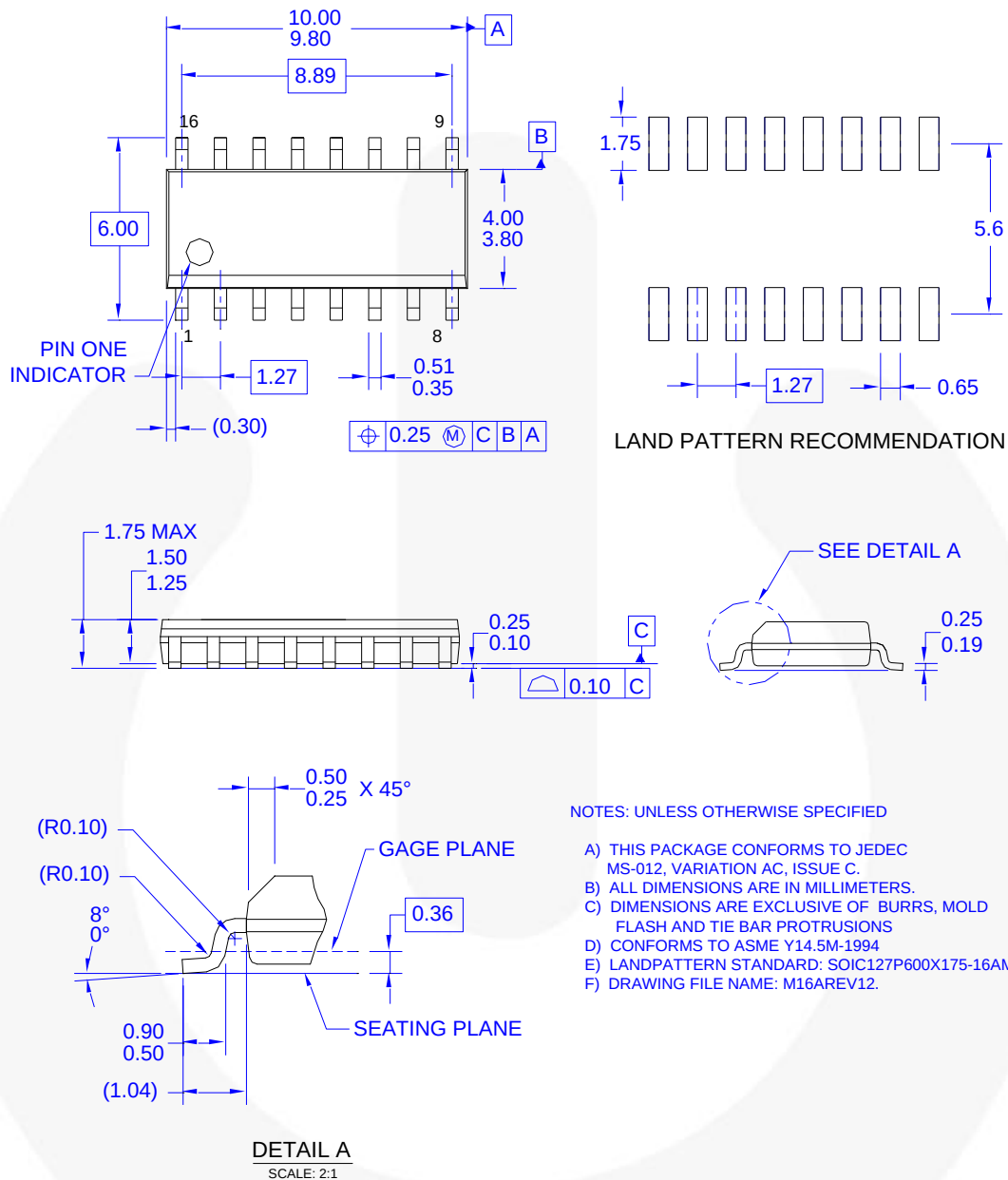


Figure 35. Typical Application Circuit

## Physical Dimension



**Figure 36. 16-Lead, Small Outline Integrated Circuit (SOIC)**

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to verify or obtain the most recent revision. Package specifications do not expand the terms of Fairchild's worldwide terms and conditions, specifically the warranty therein, which covers Fairchild products.

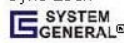
Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:  
<http://www.fairchildsemi.com/packaging/>





## TRADEMARKS

The following includes registered and unregistered trademarks and service marks, owned by Fairchild Semiconductor and/or its global subsidiaries, and is not intended to be an exhaustive list of all such trademarks.

|                                                                                   |                                                |                                                                                   |                                                                                     |
|-----------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 2Cool™                                                                            | FPST™                                          |  | Sync-Lock™                                                                          |
| AccuPower™                                                                        | F-PFST™                                        | PowerTrench®                                                                      |  |
| AX-CAP®                                                                           | FRFET®                                         | PowerXS™                                                                          | TinyBoost™                                                                          |
| BitSiC™                                                                           | Global Power Resource™                         | Programmable Active Droop™                                                        | TinyBuck™                                                                           |
| Build it Now™                                                                     | GreenBridge™                                   | QFET®                                                                             | TinyCalc™                                                                           |
| CorePLUS™                                                                         | Green FPS™                                     | QST™                                                                              | TinyLogic®                                                                          |
| CorePOWER™                                                                        | Green FPS™ e-Series™                           | Quiet Series™                                                                     | TINYOPTO™                                                                           |
| CROSSVOLT™                                                                        | Gmax™                                          | RapidConfigure™                                                                   | TinyPower™                                                                          |
| CTL™                                                                              | GTO™                                           |  | TinyPWM™                                                                            |
| Current Transfer Logic™                                                           | IntelliMAX™                                    | Saving our world, 1mW/WK/W at a time™                                             | TinyWire™                                                                           |
| DEUXPEED®                                                                         | ISOPLANAR™                                     | SignalWise™                                                                       | TranSiC™                                                                            |
| Dual Cool™                                                                        | Making Small Speakers Sound Louder and Better™ | SmartMax™                                                                         | TriFault Detect™                                                                    |
| EcoSPARK®                                                                         | MegaBuck™                                      | SMART START™                                                                      | TRUECURRENT®                                                                        |
| EfficientMax™                                                                     | MICROCOUPLER™                                  | Solutions for Your Success™                                                       | μSerDes™                                                                            |
| ESBC™                                                                             | MicroFET™                                      | SPM®                                                                              |  |
|  | MicroPak™                                      | STEALTH™                                                                          | UHC®                                                                                |
| Fairchild®                                                                        | MicroPak2™                                     | SuperFET®                                                                         | Ultra FRFET™                                                                        |
| Fairchild Semiconductor®                                                          | MillerDrive™                                   | SuperSOT™.3                                                                       | UniFET™                                                                             |
| FACT Quiet Series™                                                                | MotionMax™                                     | SuperSOT™.6                                                                       | VCX™                                                                                |
| FACT®                                                                             | mW/Saver™                                      | SuperSOT™.8                                                                       | VisualMax™                                                                          |
| FAST®                                                                             | OptoHiT™                                       | SupreMOS®                                                                         | VoltagePlus™                                                                        |
| FastvCore™                                                                        | OPTOLOGIC®                                     | SyncFET™                                                                          | XS™                                                                                 |
| FETBench™                                                                         | OPTOPLANAR®                                    |                                                                                   |                                                                                     |

\* Trademarks of System General Corporation, used under license by Fairchild Semiconductor.

## DISCLAIMER

FAIRCHILD SEMICONDUCTOR RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION, OR DESIGN. FAIRCHILD DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS. THESE SPECIFICATIONS DO NOT EXPAND THE TERMS OF FAIRCHILD'S WORLDWIDE TERMS AND CONDITIONS, SPECIFICALLY THE WARRANTY THEREIN, WHICH COVERS THESE PRODUCTS.

## LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF FAIRCHILD SEMICONDUCTOR CORPORATION.

As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury of the user.
2. A critical component in any component of a life support device, or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## ANTI-COUNTERFEITING POLICY

Fairchild Semiconductor Corporation's Anti-Counterfeiting Policy. Fairchild's Anti-Counterfeiting Policy is also stated on our external website, [www.fairchildsemi.com](http://www.fairchildsemi.com), under Sales Support.

Counterfeiting of semiconductor parts is a growing problem in the industry. All manufacturers of semiconductor products are experiencing counterfeiting of their parts. Customers who inadvertently purchase counterfeit parts experience many problems such as loss of brand reputation, substandard performance, failed applications, and increased cost of production and manufacturing delays. Fairchild is taking strong measures to protect ourselves and our customers from the proliferation of counterfeit parts. Fairchild strongly encourages customers to purchase Fairchild parts either directly from Fairchild or from Authorized Fairchild Distributors who are listed by country on our web page cited above. Products customers buy either from Fairchild directly or from Authorized Fairchild Distributors are genuine parts, have full traceability, meet Fairchild's quality standards for handling and storage and provide access to Fairchild's full range of up-to-date technical and product information. Fairchild and our Authorized Distributors will stand behind all warranties and will appropriately address any warranty issues that may arise. Fairchild will not provide any warranty coverage or other assistance for parts bought from Unauthorized Sources. Fairchild is committed to combat this global problem and encourage our customers to do their part in stopping this practice by buying direct or from authorized distributors.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

| Datasheet Identification | Product Status        | Definition                                                                                                                                                                                          |
|--------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Advance Information      | Formative / In Design | Datasheet contains the design specifications for product development. Specifications may change in any manner without notice.                                                                       |
| Preliminary              | First Production      | Datasheet contains preliminary data; supplementary data will be published at a later date. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design. |
| No Identification Needed | Full Production       | Datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve the design.                                               |
| Obsolete                 | Not In Production     | Datasheet contains specifications on a product that is discontinued by Fairchild Semiconductor. The datasheet is for reference information only.                                                    |

Rev. I64

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 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](http://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](mailto: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](http://www.onsemi.com)

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

For additional information, please contact your local  
Sales Representative