



Is Now Part of



ON Semiconductor®

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

User Guide for
FEBFL7732_L29U021A

21 W T8 LED Lamp at Universal Line
Using Buck-Boost

Featured Fairchild Product:
FL7732

***Direct questions or comments
about this evaluation board to:
“Worldwide Direct Support”***

Fairchild Semiconductor.com

Table of Contents

| | |
|---|----|
| 1. Introduction..... | 3 |
| 1.1. General Description | 3 |
| 1.2. Features | 3 |
| 1.3. Internal Block Diagram..... | 4 |
| 2. General Specifications for Evaluation Board | 5 |
| 3. Photographs and Printed Circuit Board | 6 |
| 4. Schematic..... | 7 |
| 5. Bill of Materials | 8 |
| 6. Transformer Design | 9 |
| 7. Performance of Evaluation Board..... | 10 |
| 7.1. Test Condition & Equipments | 10 |
| 7.2. Startup..... | 10 |
| 7.3. Operation Waveforms..... | 11 |
| 7.4. Constant-Current Regulation | 12 |
| 7.5. Open-LED and Short-LED Protections | 13 |
| 7.6. System Efficiency | 14 |
| 7.7. Power Factor & Total Harmonic Distortion (THD) | 15 |
| 7.8. Operating Temperature | 16 |
| 7.9. Electromagnetic Interference (EMI)..... | 17 |
| 8. Revision History | 18 |

This user guide supports the evaluation kit for the FL7732. It should be used in conjunction with the FL7732 datasheet as well as Fairchild's application notes and technical support team. Please visit Fairchild's website at www.fairchildsemi.com.

1. Introduction

This document describes the proposed solution for a universal line voltage T8 LED lamp using the FL7732 Primary-Side Regulator (PSR) single-stage controller. The input voltage range is $90 V_{RMS} - 265 V_{RMS}$. There is one DC output with a constant current of 300 mA at 70 V. This document contains a general description of the FL7732, the power supply specification, schematic, bill of materials, and typical operating characteristics.

1.1. General Description

The FL7732 is an active Power Factor Correction (PFC) controller using single-stage flyback or buck-boost topology. Primary-side regulation and single-stage topology reduce external components, such as input bulk capacitor and feedback circuitry, and minimize cost. To improve power factor and Total Harmonic Discharge (THD), constant on-time control is utilized with an internal error amplifier and a low-bandwidth compensator. Precise constant-current control regulates accurate output current, independent of input voltage and output voltage. Operating frequency is proportionally changed by output voltage to guarantee DCM operation with high efficiency and simple design. The FL7732 provides open-LED, short-LED, and over-temperature protections.

1.2. Features

- Cost-Effective Solution: No Input Bulk Capacitor and Feedback Circuitry
- Power Factor Correction (PFC)
- Accurate Constant-Current (CC) Control
- Linear Frequency Control for Better Efficiency and Simpler Design
- Open-LED Protection
- Short-LED Protection
- Cycle-by-Cycle Current Limiting
- Over-Temperature Protection (OTP) with Auto Restart
- Low Startup Current: 20 μ A
- Low Operating Current: 5 mA
- V_{DD} Under-Voltage Lockout (UVLO)
- Gate Output Maximum Voltage Clamped at 18 V
- SOP-8 Package

1.3. Internal Block Diagram

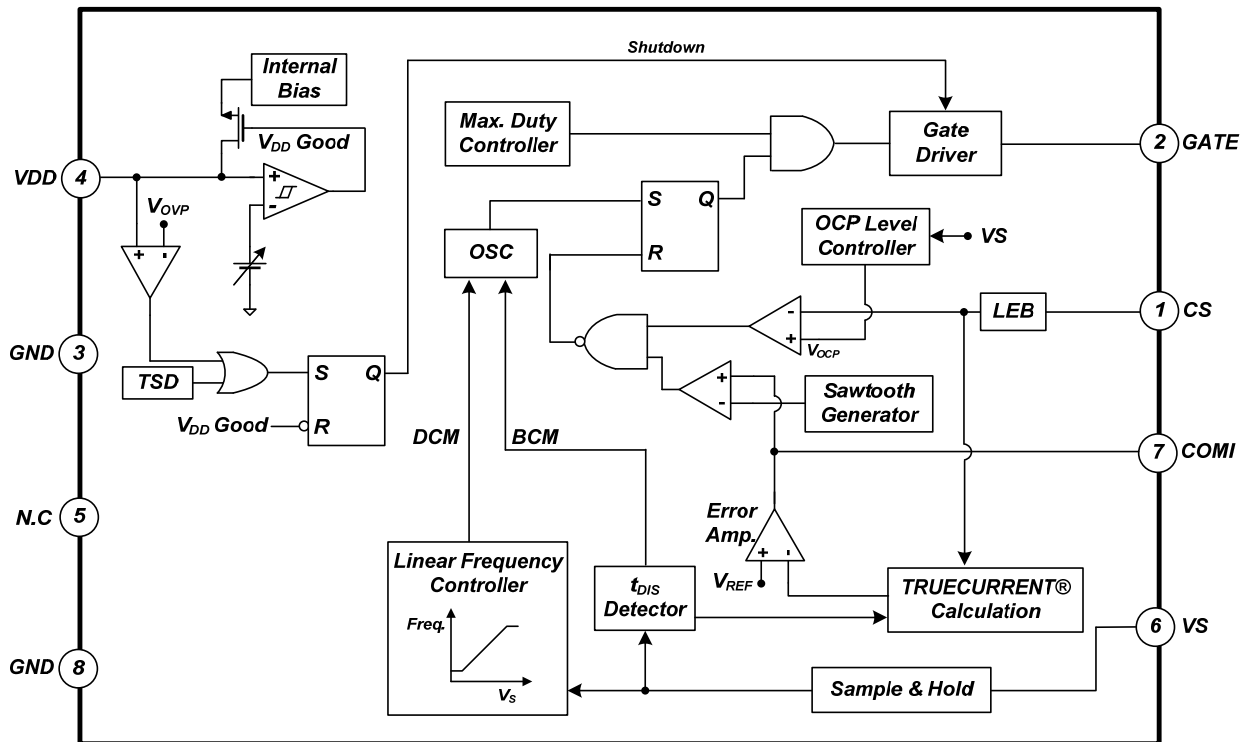


Figure 1. Block Diagram of FL7732

2. General Specifications for Evaluation Board

Table 1. Evaluation Board Specifications for LED Lighting Lamp

| Description | | Symbol | Value | Comments |
|-------------|--------------|----------------------------|----------------|---|
| Input | Voltage | V _{IN.MIN} | 90 V | Minimum Input Voltage |
| | | V _{IN.MAX} | 265 V | Maximum Input Voltage |
| | | V _{IN.NOMINAL} | 120 V / 230 V | Nominal Input Voltage |
| | Frequency | f _{IN} | 60 Hz / 50 Hz | Line Frequency |
| Output | Voltage | V _{OUT.MIN} | 40 V | Minimum Output Voltage |
| | | V _{OUT.MAX} | 80 V | Maximum Output Voltage |
| | | V _{OUT.NOMINAL} | 70 V | Nominal Output Voltage |
| | Current | I _{OUT.NOMINAL} | 300 mA | Nominal Output Current |
| | | CC Deviation | < ±3.30% | Line Input Voltage Change: 90 V _{AC} ~ 265 V _{AC} |
| | | | < ±2.65% | Output Voltage Change: 40 V ~ 80 V |
| Efficiency | | Eff _{90VAC} | 90.23% | Efficiency at 90 V _{AC} Line Input Voltage |
| | | Eff _{120VAC} | 91.88% | Efficiency at 120 V _{AC} Line Input Voltage |
| | | Eff _{140VAC} | 92.40% | Efficiency at 140 V _{AC} Line Input Voltage |
| | | Eff _{180VAC} | 92.99% | Efficiency at 180 V _{AC} Line Input Voltage |
| | | Eff _{230VAC} | 92.83% | Efficiency at 230 V _{AC} Line Input Voltage |
| | | Eff _{265VAC} | 92.42% | Efficiency at 265 V _{AC} Line Input Voltage |
| PF/THD | | PF / THD _{90VAC} | 0.989 / 12.69% | PF / THD at 90 V _{AC} Line Input Voltage |
| | | PF / THD _{120VAC} | 0.992 / 11.14% | PF / THD at 120 V _{AC} Line Input Voltage |
| | | PF / THD _{140VAC} | 0.988 / 12.21% | PF / THD at 140 V _{AC} Line Input Voltage |
| | | PF / THD _{180VAC} | 0.980 / 15.67% | PF / THD at 180 V _{AC} Line Input Voltage |
| | | PF / THD _{230VAC} | 0.964 / 20.48% | PF / THD at 230 V _{AC} Line Input Voltage |
| | | PF / THD _{265VAC} | 0.950 / 23.31% | PF / THD at 265 V _{AC} Line Input Voltage |
| Temperature | MOSFET | T _{MOSFET} | 55.1°C | Primary MOSFET Temperature |
| | Output Diode | T _{DIODE} | 58.4°C | Secondary Diode Temperature |

All data was measured with the board enclosed in a case and external temperature ~25°C.

3. Photographs and Printed Circuit Board

Dimensions: 284 (L) × 17 (W) × 10 (H) [mm].



Figure 2. Top / Bottom of Evaluation Board

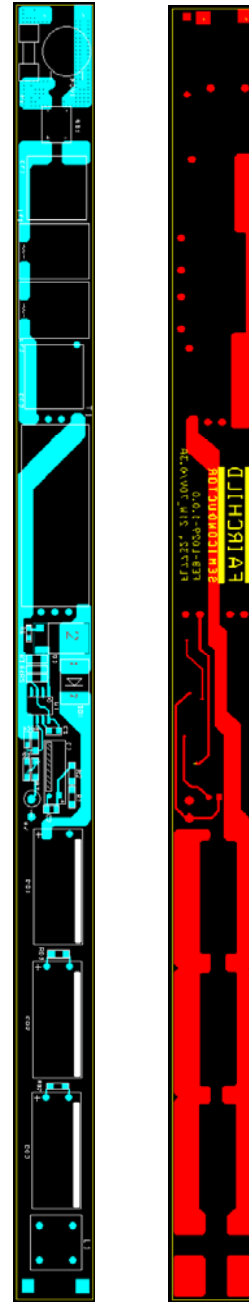


Figure 3. PCB Pattern Top / Bottom of Evaluation Board

4. Schematic

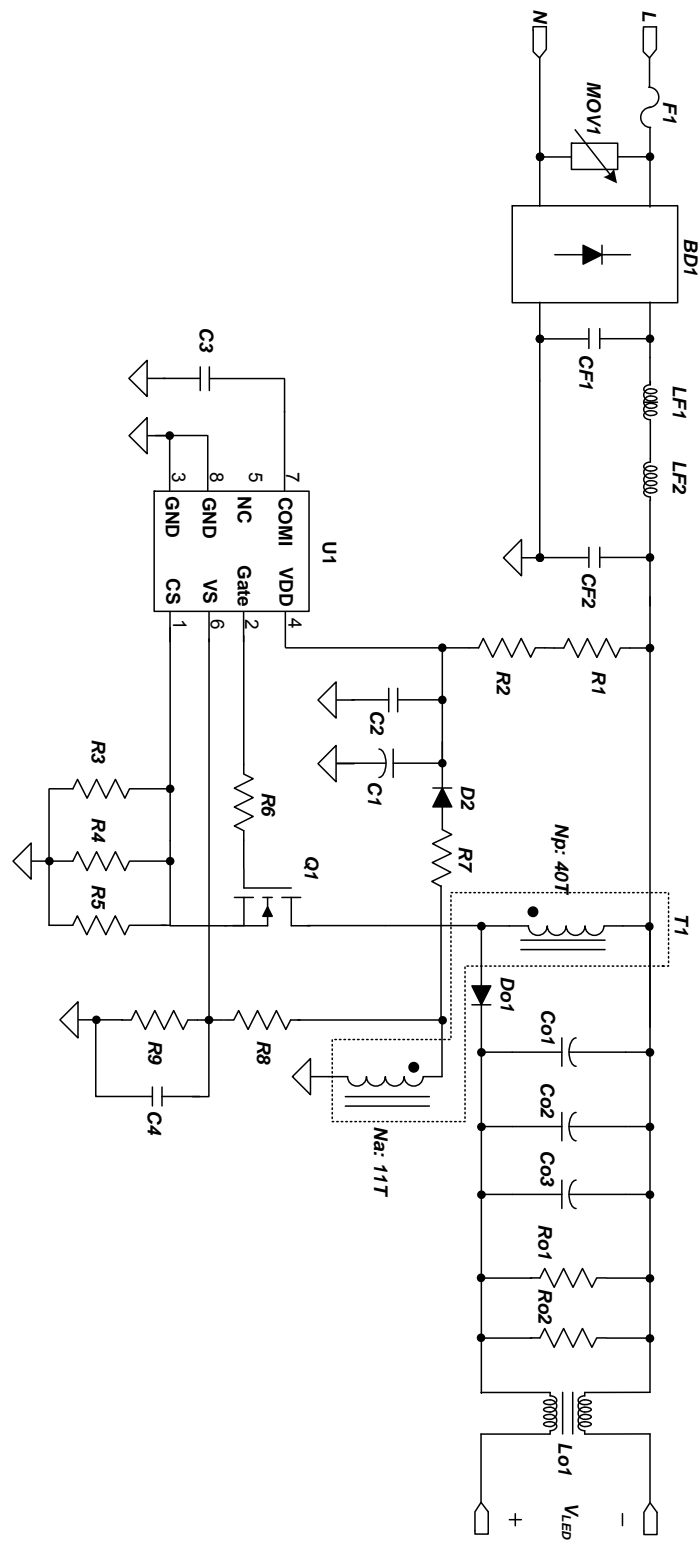


Figure 4. Evaluation Board Schematic

5. Bill of Materials

| Item No. | Part Reference | Part Number | Qty. | Description | Manufacturer |
|----------|----------------|-------------------------|------|--|-------------------------|
| 1 | BD1 | DF06S | 1 | 1.5 A / 600 V Bridge Diode | |
| 2 | CF1, CF2 | MPE 400 V 104 K | 2 | 100 nF / 400 V MPE Film Capacitor | Sungho |
| 3 | C1 | KMG 22 μ F / 35 V | 1 | 22 μ F / 35 V Electrolytic Capacitor | Samyoung |
| 4 | C2 | C0805C104K5RACTU | 1 | 0.1 μ F / 50 V SMD Capacitor 2012 | Kemet |
| 5 | C3 | C1206C225K3PACTU | 1 | 2.2 μ F / 25 V SMD Capacitor 2012 | Kemet |
| 6 | C4 | C0805C200J3GACTU | 1 | 20 pF / 25 V, SMD Capacitor 2012 | Kemet |
| 7 | Co1, Co2, Co3 | KMG 100 μ F / 100 V | 3 | 100 μ F / 100 V Electrolytic Capacitor | Samyoung |
| 8 | D2 | 1N4003 | 1 | 200 V / 1 A, General Purpose Rectifier | Fairchild Semiconductor |
| 9 | Do1 | ES3J | 1 | 600 V / 3 A, Fast Rectifier | Fairchild Semiconductor |
| 10 | F1 | SS-5-1A | 1 | 1 A / 250 V, Fuse | Littelfuse |
| 11 | LF1, LF2 | R10402KT00 | 2 | 4 mH Inductor, 10 \emptyset | Hanamelec |
| 12 | L1 | LF10S-501-2A | 1 | 500 μ H | Hanamelec |
| 13 | MOV1 | 10D471K | 1 | VARISTOR 470 V 10MM RADIAL | Bourns Inc. |
| 14 | Q1 | FCD900N60Z | 1 | 4.5 A / 600 V Main MOSFET | Fairchild Semiconductor |
| 15 | R1, R2 | RC1206JR-07100KL | 2 | 100 k Ω SMD Resistor 3216 | Yageo |
| 16 | R3 | RC1206JR-071R1L | 1 | 1.1 Ω SMD Resistor 3216 | Yageo |
| 17 | R4, R5 | RC1206FR-071RL | 2 | 1.0 Ω SMD Resistor 3216 | Yageo |
| 18 | R6 | RC0805JR-0720RL | 1 | 20 Ω SMD Resistor 2012 | Yageo |
| 19 | R7 | RC1206JR-070RL | 1 | 0 Ω SMD Resistor 3216 | Yageo |
| 20 | R8 | RC1206JR-07150KL | 1 | 150 k Ω SMD Resistor 3216 | Yageo |
| 21 | R9 | RC1206JR-0724KL | 1 | 24 k Ω SMD Resistor 3216 | Yageo |
| 22 | Ro1, Ro2 | RC1206JR-0743kL | 2 | 43 k Ω SMD Resistor 3216 | Yageo |
| 23 | T1 | EEW1328 | 1 | Transformer, 450 μ H | Sejin-electronics |
| 24 | U1 | FL7732M_F116 | 1 | Main PSR Controller | Fairchild Semiconductor |

6. Transformer Design

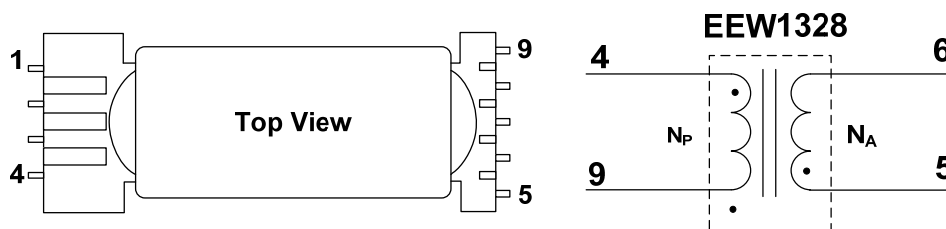


Figure 5. Transformer Bobbin Structure and Pin Configuration

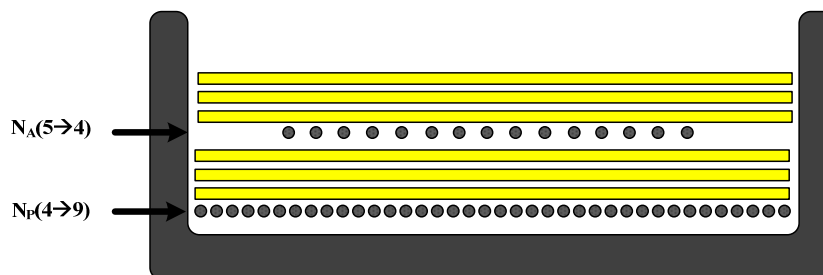


Figure 6. Transformer Winding Structure

Table 2. Winding Specifications

| No | Winding | Pin(S → F) | Wire | Turns | Winding Method |
|----|--|------------|------------|-------|------------------|
| 1 | Np | 4 → 9 | 0.33Ø | 40 Ts | Solenoid Winding |
| 2 | Insulation: Polyester Tape t = 0.025 mm, 3-Layer | | | | |
| 3 | Na | 5 → 6 | 0.25Ø[TIW] | 11 Ts | Solenoid Winding |
| 4 | Insulation: Polyester Tape t = 0.025 mm, 3-Layer | | | | |

Table 3. Electrical Characteristics.

| | Pin | Specification | Remark |
|------------|------|---------------|-----------------------------------|
| Inductance | 4– 9 | 450 µH ± 10% | 60 kHz, 1 V |
| Leakage | | 5 µH | 60 kHz, 1 V Short all Output Pins |

7. Performance of Evaluation Board

7.1. Test Condition & Equipments

| Ambient Temperature | $T_A = 25^\circ\text{C}$ |
|---------------------|---|
| Test Equipment | AC Power Source: PCR500L by Kikusui Power Analyzer: PZ4000 by YOKOGAWA Oscilloscope: WaveRunner 104Xi by LeCroy EMI Test Receiver: ESCS30 by ROHDE & SCHWARZ Two-Line V-Network: ENV216 by ROHDE & SCHWARZ Thermometer: Therna CAM SC640 by FLIR SYSTEMS LED: EHP-AX08EL/GT01H-P03(3W) by Everlight |

7.2. Startup

Startup time is 0.88 s ($V_{IN} = 90\text{ V}_{AC}$) \sim 0.35 s ($V_{IN} = 265\text{ V}_{AC}$).

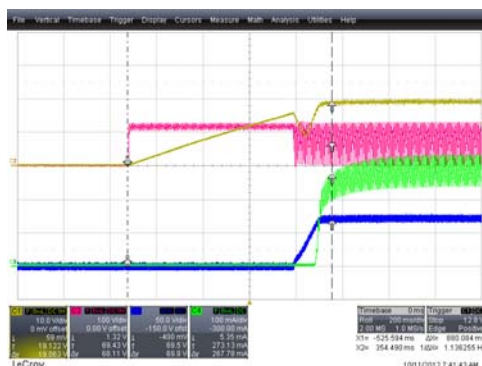


Figure 7. $V_{IN} = 90\text{ V}_{AC} / 60\text{ Hz}$, Startup Time at LED ($70\text{ V} / 300\text{ mA}$);
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]



Figure 8. $V_{IN} = 120\text{ V}_{AC} / 60\text{ Hz}$ Startup Time at LED ($70\text{ V} / 300\text{ mA}$);
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

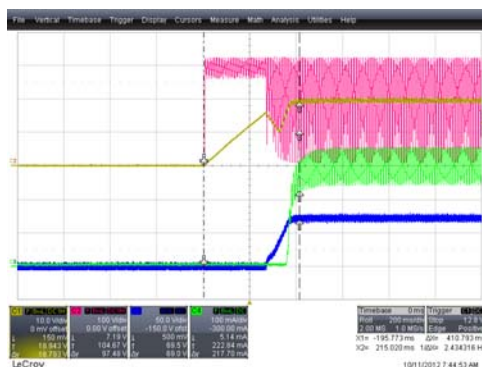


Figure 9. $V_{IN} = 230\text{ V}_{AC} / 50\text{ Hz}$, Startup Time at LED ($70\text{ V} / 300\text{ mA}$);
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

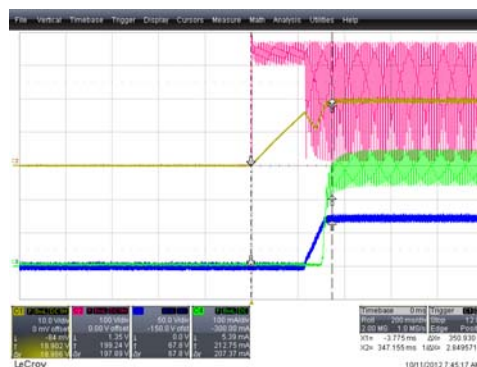


Figure 10. $V_{IN} = 265\text{ V}_{AC} / 50\text{ Hz}$, Startup Time at LED ($70\text{ V} / 300\text{ mA}$);
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

7.3. Operation Waveforms

Output current ripple is under 52 mAp-p at rated output current.

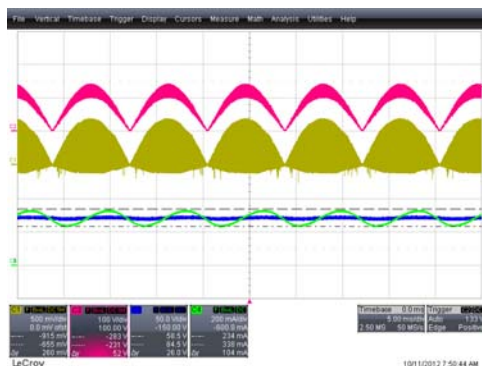


Figure 11. $V_{IN} = 90 \text{ V}_{AC} / 60 \text{ Hz}$, Operation Waveforms at LED (70 V / 300 mA); C1 [V_{CS}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

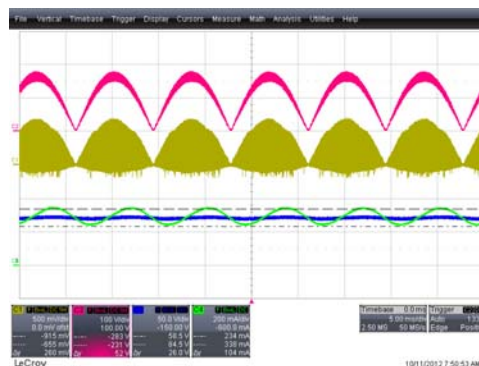


Figure 12. $V_{IN} = 120 \text{ V}_{AC} / 60 \text{ Hz}$ Operation Waveforms at LED (70 V / 300 mA); C1 [V_{CS}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

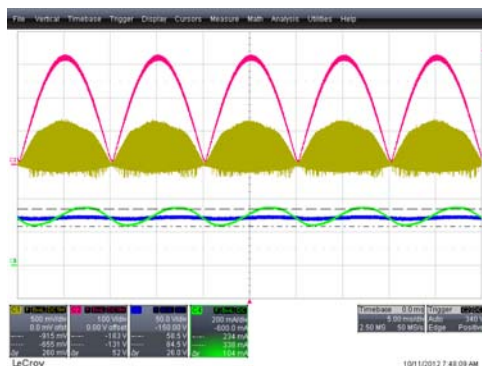


Figure 13. $V_{IN} = 230 \text{ V}_{AC} / 50 \text{ Hz}$, Operation Waveforms at LED (70 V / 300 mA); C1 [V_{CS}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

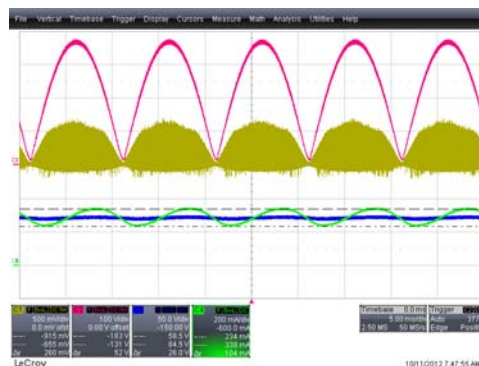


Figure 14. $V_{IN} = 265 \text{ V}_{AC} / 50 \text{ Hz}$, Operation Waveforms at LED (70 V / 300 mA); C1 [V_{CS}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

7.4. Constant-Current Regulation

Constant-current deviation in the wide output voltage range from 40 V to 80 V is less than $\pm 2.7\%$ at each line input voltage. Line regulation is less than $\pm 3.5\%$. The results were measured using E-load [CR Mode].

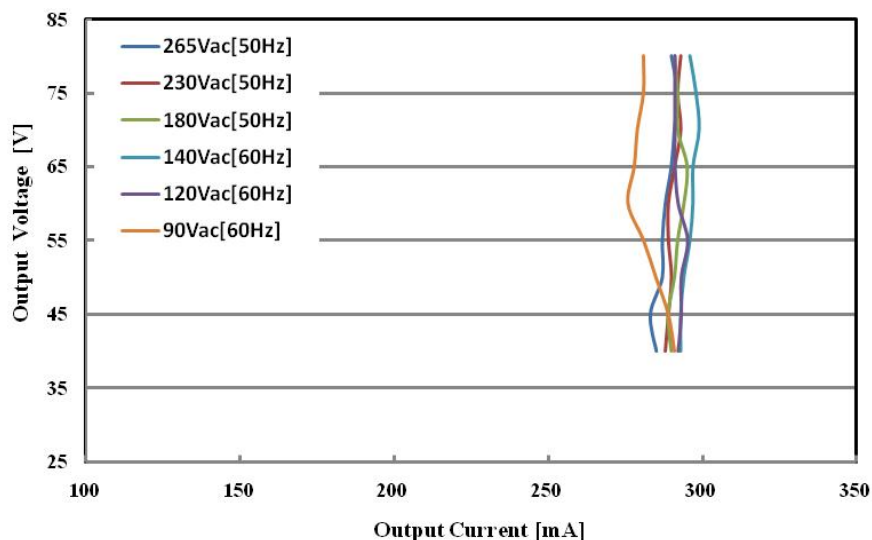


Figure 15. Constant-Current Regulation – Measured by E-Load

Table 4. Constant-Current Regulation by Output Voltage Change (40 V ~ 80 V)

| Input Voltage | Min. Current [A] | Max. Current [A] | Tolerance |
|-----------------------------|------------------|------------------|--------------|
| 90 V _{AC} [60 Hz] | 0.283 | 0.292 | $\pm 1.57\%$ |
| 120 V _{AC} [60 Hz] | 0.288 | 0.293 | $\pm 0.86\%$ |
| 140 V _{AC} [60 Hz] | 0.289 | 0.295 | $\pm 1.03\%$ |
| 180 V _{AC} [50 Hz] | 0.293 | 0.299 | $\pm 1.01\%$ |
| 230 V _{AC} [50 Hz] | 0.291 | 0.295 | $\pm 0.68\%$ |
| 265 V _{AC} [50 Hz] | 0.276 | 0.291 | $\pm 2.65\%$ |

Table 5. Constant-Current Regulation by Line Voltage Change (90 V_{AC} ~ 265 V_{AC})

| Output Voltage | 90 V _{AC} | 120 V _{AC} | 140 V _{AC} | 180 V _{AC} | 230 V _{AC} | 265 V _{AC} | Tolerance |
|----------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|--------------|
| 75 V | 0.281 A | 0.291 A | 0.298 A | 0.292 A | 0.292 A | 0.292 A | $\pm 2.94\%$ |
| 70 V | 0.279 A | 0.291 A | 0.299 A | 0.292 A | 0.293 A | 0.291 A | $\pm 3.46\%$ |
| 65 V | 0.278 A | 0.291 A | 0.297 A | 0.295 A | 0.291 A | 0.290 A | $\pm 3.30\%$ |

7.5. Open-LED and Short-LED Protections

In short-LED condition, the OCP level is reduced from 0.7 V to 0.2 V because the FL7732 lowers the OCP level when the V_S voltage is less than 0.4 V during output diode conduction time. The results were measured using actual LED load.

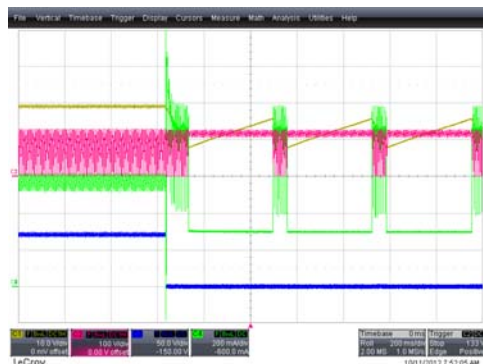


Figure 16. $V_{IN} = 90 V_{AC} / 60 \text{ Hz}$, Short-LED;
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

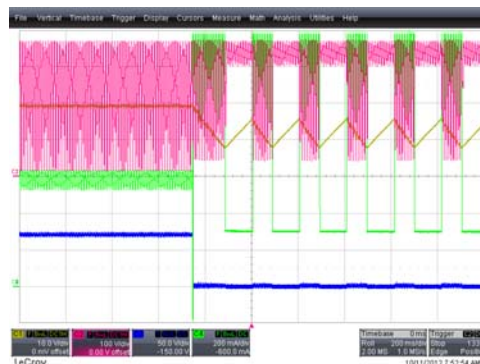


Figure 17. $V_{IN} = 265 V_{AC} / 50 \text{ Hz}$, Short-LED;
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

In open-LED condition, output voltage is limited around 30 V by OVP in V_{DD} . Output over-voltage protection level can be controlled by the turn ratio of the auxiliary and secondary windings.

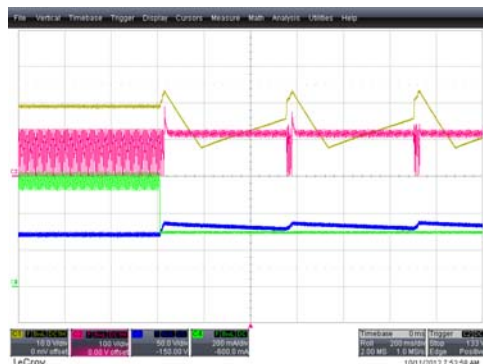


Figure 18. $V_{IN} = 90 V_{AC} / 60 \text{ Hz}$, Open-LED;
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

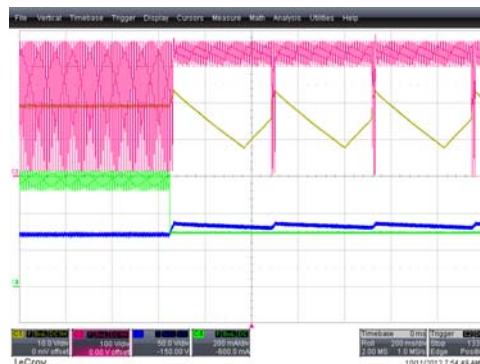


Figure 19. $V_{IN} = 265 V_{AC} / 50 \text{ Hz}$, Open-LED;
C1 [V_{DD}], C2 [V_{IN}], C3 [V_{OUT}], C4 [I_{OUT}]

7.6. System Efficiency

System efficiency is 90.23% ~ 92.99% in 90 V_{AC} ~ 265 V_{AC} input voltage range. The results were measured after 30 minutes since startup by using LED load.

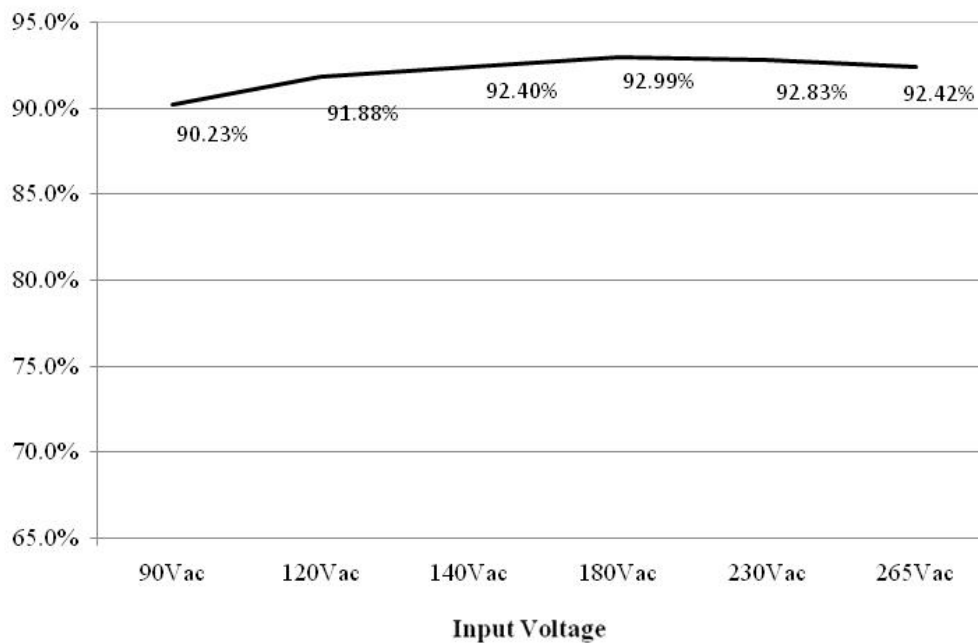


Figure 20. System Efficiency

Table 6. System Efficiency

| Input Voltage | Input Power [W] | Output Current [A] | Output Voltage [V] | Output Power [W] | Efficiency |
|-----------------------------|-----------------|--------------------|--------------------|------------------|------------|
| 90 V _{AC} [60 Hz] | 23.03 | 0.290 | 71.56 | 20.78 | 90.23% |
| 120 V _{AC} [60 Hz] | 23.62 | 0.303 | 71.72 | 21.70 | 91.88% |
| 140 V _{AC} [60 Hz] | 23.78 | 0.306 | 71.71 | 21.97 | 92.40% |
| 180 V _{AC} [50 Hz] | 23.31 | 0.303 | 71.54 | 21.68 | 92.99% |
| 230 V _{AC} [50 Hz] | 23.08 | 0.300 | 71.42 | 21.43 | 92.83% |
| 265 V _{AC} [50 Hz] | 23.03 | 0.295 | 71.27 | 21.05 | 92.42% |



7.7. Power Factor & Total Harmonic Distortion (THD)

FL7732 shows excellent THD performance. THD is much less than 30% of the specification. Power factor is very high, with enough margins from 0.9. The results were measured 30 minutes after startup using LED load.

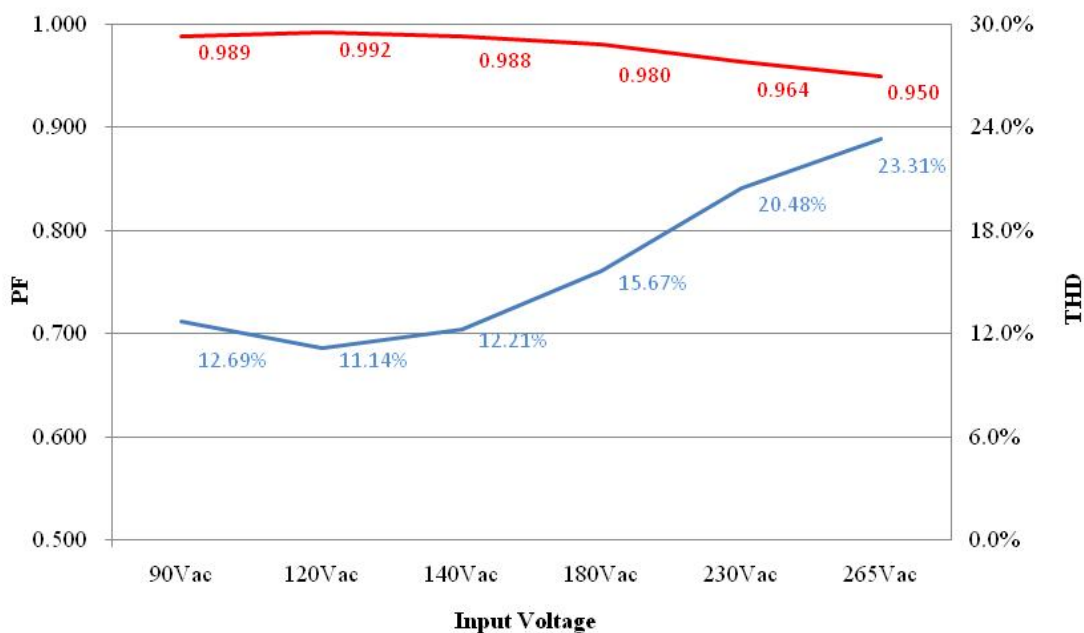


Figure 21. Power Factor & Total Harmonic Distortion

Table 7. Power Factor & Total Harmonic Distortion

| Input Voltage | PF | THD |
|-----------------------------|-------|--------|
| 90 V _{AC} [60 Hz] | 0.989 | 12.69% |
| 120 V _{AC} [60 Hz] | 0.992 | 11.14% |
| 140 V _{AC} [60 Hz] | 0.988 | 12.21% |
| 180 V _{AC} [50 Hz] | 0.980 | 15.67% |
| 230 V _{AC} [50 Hz] | 0.964 | 20.48% |
| 265 V _{AC} [50 Hz] | 0.950 | 23.31% |

7.8. Operating Temperature

Temperature of the all components on this board is less than 60°C. The results were measured 60 minutes after startup using LED load.

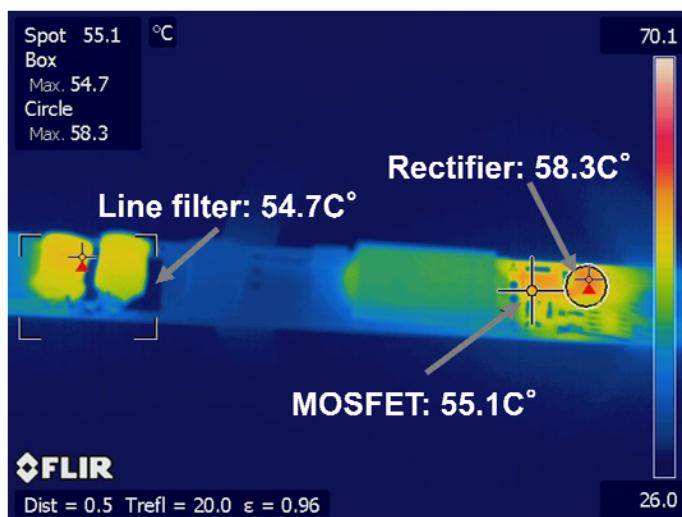


Figure 22. Board Temperature – V_{IN} [90 V_{AC} / 60 Hz], LED (70 V / 300 mA)

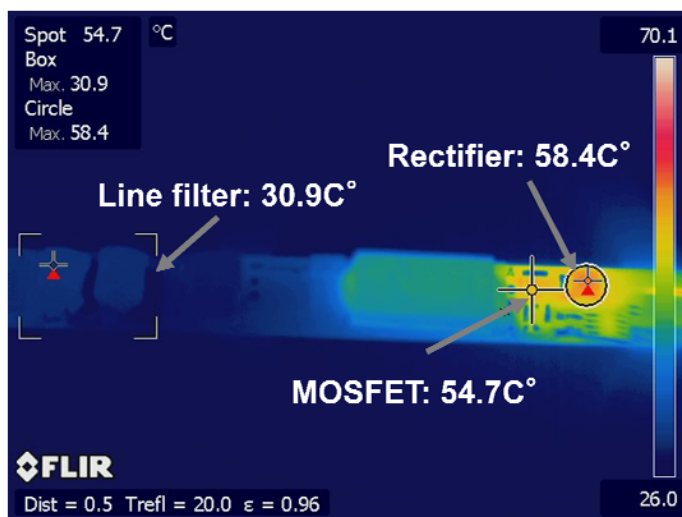


Figure 23. Board Temperature – V_{IN} [265 V_{AC} / 50 Hz], LED (70 V / 300 mA)

7.9. Electromagnetic Interference (EMI)

All measurements were conducted in observance of EN55022 criteria. The results were measured 30 minutes after startup using LED load.

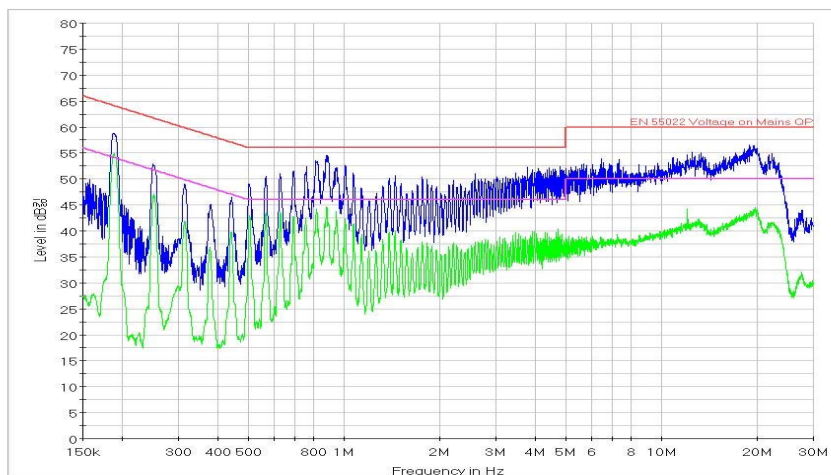


Figure 24. EMI Results – LED (70 V / 300 mA), Conduction Live; $V_{IN} = 230 V_{AC}$

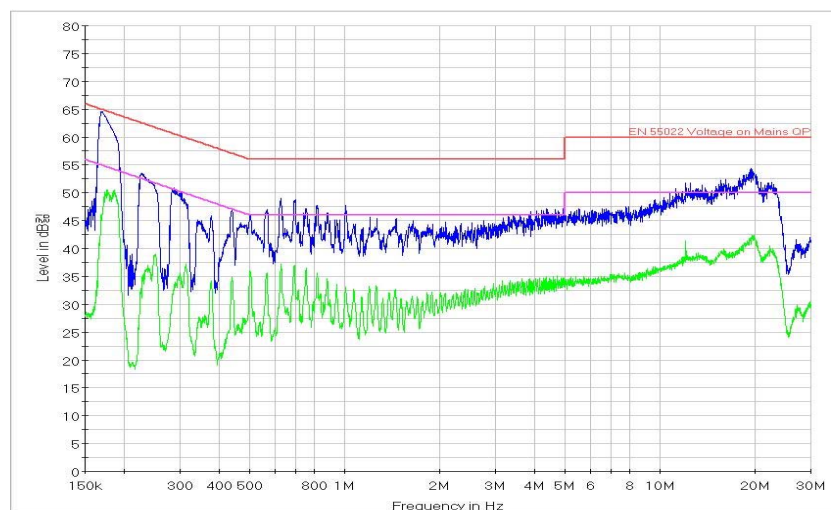


Figure 25. EMI Results – LED (70 V / 300 mA), Conduction Neutral; $V_{IN} = 110 V_{AC}$

8. Revision History

| Rev. | Date | Description |
|-------|----------|-----------------|
| 1.0.0 | Nov 2012 | Initial Release |
| | | |
| | | |
| | | |

WARNING AND DISCLAIMER

Replace components on the Evaluation Board only with those parts shown on the parts list (or Bill of Materials) in the Users' Guide. Contact an authorized Fairchild representative with any questions.

The Evaluation board (or kit) is for demonstration purposes only and neither the Board nor this User's Guide constitute a sales contract or create any kind of warranty, whether express or implied, as to the applications or products involved. Fairchild warrants that its products meet Fairchild's published specifications, but does not guarantee that its products work in any specific application. Fairchild reserves the right to make changes without notice to any products described herein to improve reliability, function, or design. Either the applicable sales contract signed by Fairchild and Buyer or, if no contract exists, Fairchild's standard Terms and Conditions on the back of Fairchild invoices, govern the terms of sale of the products described herein.

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.

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 THE PRESIDENT 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, or (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 significant injury to the user.
2. A critical component is 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, 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.

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. 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