# SG6846C
# Highly Integrated Green-Mode PWM Controller

## Features

- Low Start-up Current: 8µA

- Low Operating Current: 3.7mA

- Peak-current Mode Operation with Cycle-by-cycle Current Limiting

- PWM Frequency Continuously Decreasing with Burst Mode at Light Loads

- $V_{DD}$ Over-Voltage Protection (OVP)

- AC Input Brownout Protection with Hysteresis

- Constant Output Power Limit (Full AC Input Range)

- Internal Latch Circuit for OVP, OTP, and OCP

- Two-level OCP Delay: 110ms

- Programmable PWM Frequency with Frequency Hopping

- OCP Threshold is Half Peak Current Limit

- Feedback Open-loop Protection with 110ms Delay

- Soft Start-up Time: 5ms

## Applications

General-purpose switch mode power supplies and flyback power converters, including:

- Power Adapters

- Open-frame SMPS

- SMPS with Surge-current Output, such as for Printers, Scanners, Motor Drivers

## Description

A highly integrated PWM controller, SG6846C provides several features to enhance the performance of flyback converters. To minimize standby power consumption, a proprietary green-mode function provides off-time modulation to continuously decrease the switching frequency under light-load conditions. Under zero-load conditions, the power supply enters burst-mode, which completely shuts off PWM output. Output restarts just before the supply voltage drops below the UVLO lower limit. This green-mode function enables power supplies to meet international power conservation requirements.

The SG6846C is designed for SMPS with surge-current output, incorporated with a two-level OCP function. Besides the cycle-by-cycle current limiting, if the switching current is higher than OCP threshold and lasts for 110ms, SG6846C shuts down immediately. SG6846C also integrates frequency-hopping function internally, which helps reduce EMI emission of a power supply with minimum line filters. The built-in synchronized slope compensation provides proprietary internal compensation for constant output power limit over a universal AC input range. The gate output is clamped at 18V to protect the external MOSFET from over-voltage damage.

Other protection functions include AC input brownout protection with hysteresis and $V_{DD}$ over-voltage protection. For over-temperature protection, an external NTC thermistor can be applied to sense the ambient temperature. When OCP, $V_{DD}$ OVP, or OTP are activated, an internal latch circuit latches off the controller. The latch resets when $V_{DD}$ supply is removed.

SG6846C is available in 8-pin SOP and DIP packages.

## Ordering Information

| Part Number | Operating Temperature Range | OCP Latch | Package |
|---|---|---|---|
| SG6846CLSZ | -20 to +85°C | Yes | 8-Pin Small Outline Package (SOP) |
| SG6846CLDZ | -20 to +85°C | Yes | 8-Pin Dual Inline Package (DIP) |

All standard Fairchild Semiconductor products are RoHS compliant and many are also "GREEN" or going green. *For Fairchild's definition of "green" please visit: http://www.fairchildsemi.com/company/green/rohs_green.html*.
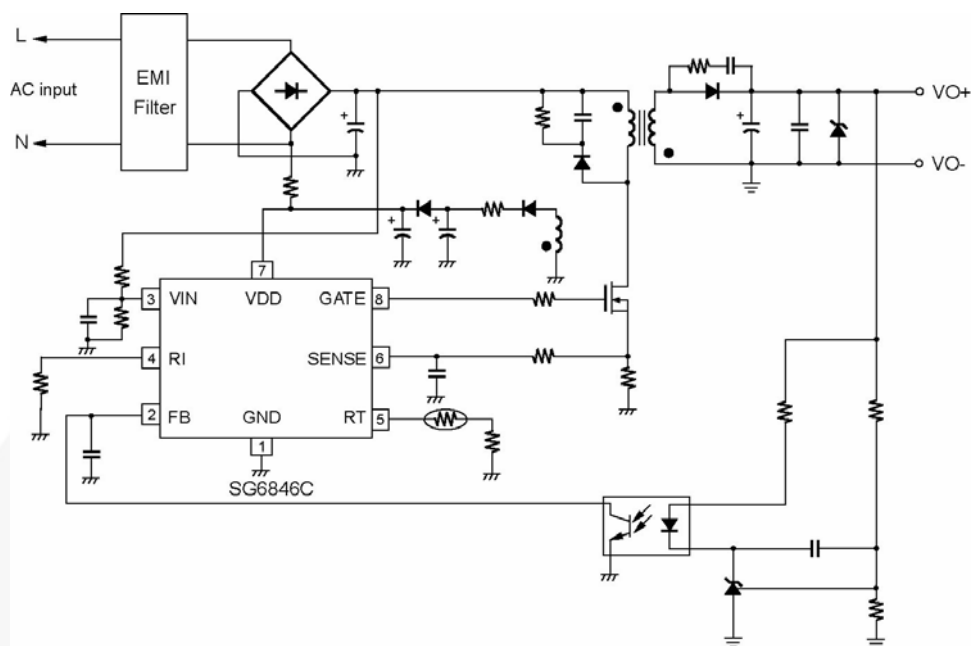
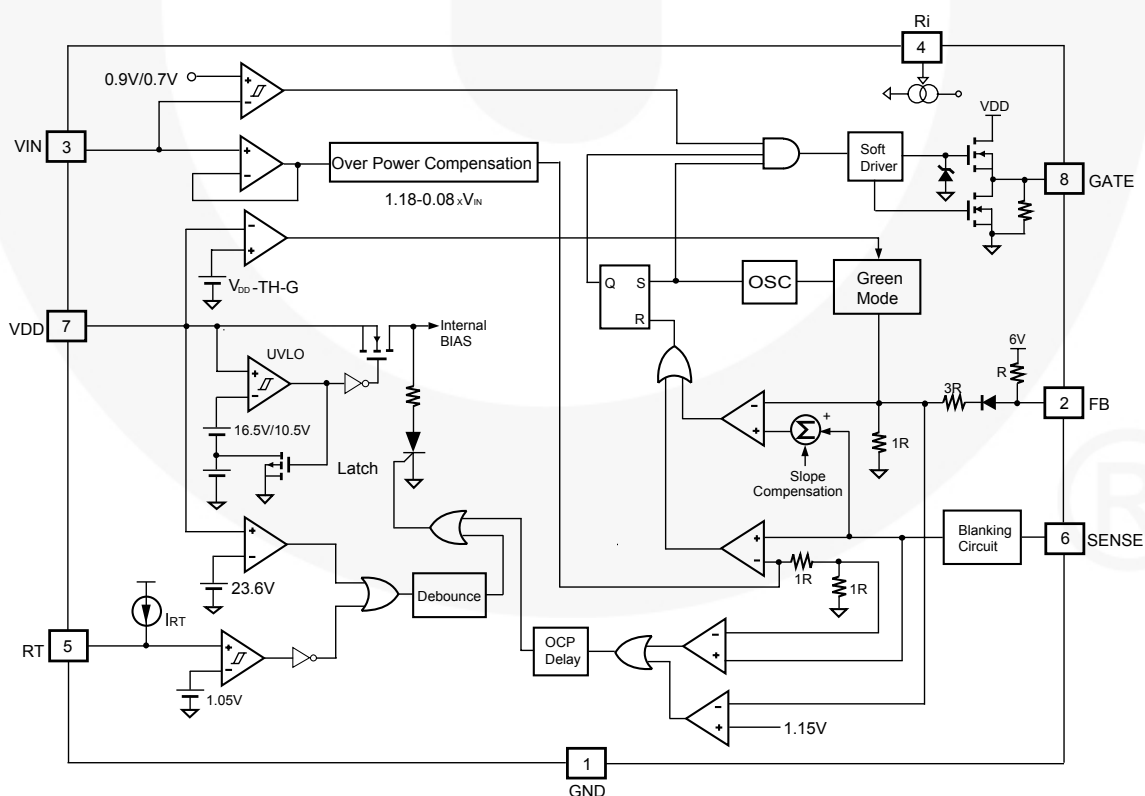## Typical Application



**Figure 1.   Typical Application**
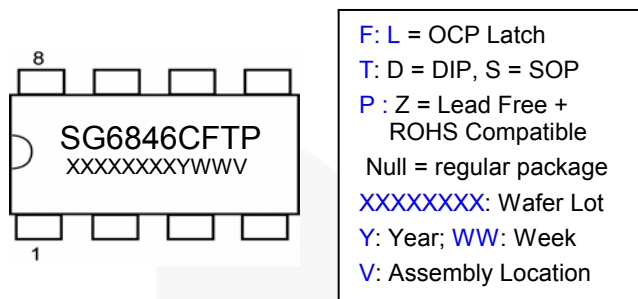
## Block Diagram



**Figure 2.   Block Diagram**

## Marking Information

SG6846CFTP

XXXXXXXXYWWV

8

1

F: L = OCP Latch

T: D = DIP, S = SOP

P : Z = Lead Free +
ROHS Compatible

Null = regular package

XXXXXXXX: Wafer Lot

Y: Year; WW: Week

V: Assembly Location

**Figure 3. Top Mark**

## Pin Configuration

GND 1 8 GATE
FB 2 7 VDD
VIN 3 6 SENSE
RI 4 5 RT
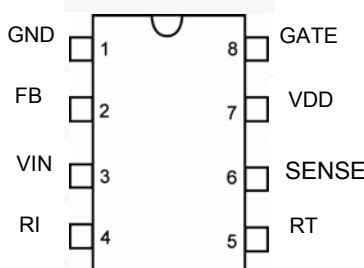
**Figure 4. Pin Configuration**

## Pin Definitions

| Pin # | Name | Function | Description |
|-------|------|----------|-------------|
| 1 | GND | Ground | Ground. |
| 2 | FB | Feedback | The signal from the external compensation circuit is fed into this pin. The PWM duty cycle is determined in response to the signal from this pin and the current-sense signal from pin 6. |
| 3 | VIN | Line-voltage Detection | Line-voltage detection, used for brownout protection with hysteresis. Constant output power limit over universal AC input range is also achieved using this pin. Add a low-pass filter to filter out line ripple on bulk capacitor. |
| 4 | RI | Reference Setting | A resistor from the RI pin to ground generates a reference current source that determines the switching frequency. Increasing the resistance reduces the switching frequency. Using a 26kΩ resistor results in a 65kHz switching frequency. |
| 5 | RT | Temperature Detection | For over-temperature protection, an external NTC thermistor is connected from this pin to the GND pin. The impedance of the NTC decreases at high temperatures. Once the voltage of the RT pin drops below a threshold, PWM output is disabled. |
| 6 | SENSE | Current Sense | Current sense. The sensed voltage is used for peak-current-mode control and cycle-by-cycle current limiting. If the switching current is higher than OCP threshold and lasts for 110ms, SG6846C turns off immediately. This two-level OCP feature is especially suitable for SMPS with surge current output. |
| 7 | VDD | Power Supply | Power supply. If an open-circuit failure occurs in the feedback loop, the internal protection circuit disables PWM output as long as $V_{DD}$ exceeds a threshold. |
| 8 | GATE | Driver Output | The totem-pole output driver for the power MOSFET. It is internally clamped below 18V. |

## 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. All voltage values, except differential voltages, are given with respect to GND pin.

| Symbol | Parameter | | Min. | Max. | Unit |
|---|---|---|---|---|---|
| $V_{DD}$ | Supply Voltage | | | 25 | V |
| $V_L$ | Input Voltage to FB, SENSE, VIN, RT,RI Pin | | -0.3 | 7.0 | V |
| $P_D$ | Power Dissipation at $T_A$<50°C | DIP | | 800 | mW |
| | | SOP | | 400 | |
| $\Theta_{JC}$ | Thermal Resistance (Junction-to-Case) | DIP | | 67.1 | °C/W |
| | | SOP | | 54.4 | |
| $T_J$ | Operating Junction Temperature | | -40 | +150 | °C |
| $T_{STG}$ | Storage Temperature Range | | -65 | +150 | °C |
| $T_L$ | Lead Temperature, Wave Soldering, 10 Seconds | | | +260 | °C |
| ESD | Electrostatic Discharge Capability | Human Body Model | | 5.5 | kV |
| | | Machine Model | | 250 | 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. | Max. | Unit |
|---|---|---|---|---|
| $T_A$ | Operating Ambient Temperature | -20 | +85 | °C |

## Electrical Characteristics

$V_{DD}$ = 15V, $T_A$ = 25°C, unless noted.

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|----------------|------|------|------|------|
| **$V_{DD}$ Section** | | | | | | |
| $V_{DD-OP}$ | Continuously Operating Voltage | | | | 20 | V |
| $V_{DD-ON}$ | Turn-on Threshold Voltage | | 15.5 | 16.5 | 17.5 | V |
| $V_{DD-OFF}$ | Turn-off Voltage | | 9.5 | 10.5 | 11.5 | V |
| $V_{DD-LH}$ | Threshold Voltage for Latch-off Release | | 3 | 4 | 5 | V |
| $I_{DD-ST}$ | Start-up Current | $V_{DD-ON}$ – 0.16V | | 8 | 30 | μA |
| $I_{DD-OP}$ | Operating Supply Current | GATE Open | | 3.7 | 5.0 | mA |
| $V_{DD-OVP}$ | $V_{DD}$ Over-Voltage Protection (Latch off) | | 22.6 | 23.6 | 24.6 | V |
| $t_{D-VDDOVP}$ | $V_{DD}$ OVP Debounce Time | $R_I$ = 26kΩ | 60 | 100 | 140 | μs |
| $I_{DD-OVP}$ | $V_{DD}$ OVP Latch-off Holding Current | $V_{DD}$ = 5V | 30 | 50 | 70 | μA |
| **$V_{IN}$ Section** | | | | | | |
| $V_{IN-OFF}$ | PWM Turn-off Threshold Voltage | | 0.65 | 0.70 | 0.75 | V |
| $V_{IN-ON}$ | PWM Turn-on Threshold Voltage | | $V_{IN-OFF}$+0.18 | $V_{IN-OFF}$+0.20 | $V_{IN-OFF}$+0.22 | V |
| **Feedback Input Section** | | | | | | |
| $A_V$ | Input-Voltage to Current-Sense Attenuation | | 1/3.5 | 1/4.0 | 1/4.5 | V/V |
| $Z_{FB}$ | Input Impedance | | 4.0 | 5.5 | 7.0 | kΩ |
| $V_{FBO}$ | FB Pin Open Voltage | | | 6.2 | | V |
| $V_{FB-OLP}$ | Threshold Voltage of Open-loop Protection | | 4.7 | 5.2 | 5.7 | V |
| $t_{D-OLP}$ | Open-loop Protection Delay Time | $R_I$ = 26kΩ | 100 | 110 | 120 | ms |
| **Current Sense Section** | | | | | | |
| $Z_{SENSE}$ | Input Impedance | | | 12 | | kΩ |
| $t_{PD}$ | Delay to Output | | | 100 | 250 | ns |
| $t_{LEB}$ | Leading-edge Blanking Time | | 270 | 360 | | ns |
| $V_{SLOPE}$ | Slope Compensation | Duty = $DCY_{MAX}$ | 0.30 | 0.33 | 0.36 | V |
| $V_{STH1V}$ | Threshold Voltage for Current Limit | $V_{IN}$ = 1V | 1.07 | 1.10 | 1.13 | V |
| $V_{STH3V}$ | Threshold Voltage for Current Limit | $V_{IN}$ = 3V | 0.91 | 0.94 | 0.97 | V |
| $V_{STH1V-1/2}$ | OCP Threshold Voltage for Current Limit | $V_{IN}$ = 1V | 0.52 | 0.55 | 0.58 | V |
| $V_{STH3V-1/2}$ | OCP Threshold Voltage for Current Limit | $V_{IN}$ = 3V | 0.44 | 0.47 | 0.50 | V |
| $t_{D-OCP}$ | Delay Time for Over-Current Protection | $R_I$ = 26kΩ | 100 | 110 | 120 | ms |
| $t_{SS-65KHz}$ | Period During Start up Time | $R_I$ = 26kΩ | 4.5 | 5.0 | 5.5 | ms |
| $t_{SS-130KHz}$ | Period During Start up Time | $R_I$ = 13kΩ | 2.25 | 2.50 | 2.75 | ms |

*Continued on following page…*

## Electrical Characteristics (Continued)

$V_{DD}$ = 15V, $T_A$ = 25°C, unless noted.

| Symbol | Parameter | | Test Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| **Oscillator Section** | | | | | | | |
| $f_{OSC}$ | Normal PWM Frequency | Center Frequency | $R_I$ = 26kΩ, $V_{FB}>V_N$ | 62 | 65 | 68 | kHz |
| | | Jitter Range | | ±3.7 | ±4.2 | ±4.7 | |
| $f_{OSC,MAX}$ | Maximum PWM Frequency | Center Frequency | $R_I$ = 13kΩ, $V_{FB}>V_N$ | 124 | 130 | 136 | kHz |
| | | Jitter Range | | ±7.4 | ±8.4 | ±9.4 | |
| $f_{OSC,MIN}$ | Minimum PWM Frequency | Center Frequency | $R_I$ = 36kΩ, $V_{FB}>V_N$ | 44.8 | 47.0 | 49.2 | kHz |
| | | Jitter Range | | ±2.54 | ±2.90 | ±3.26 | |
| $t_{hop-1}$ | Jitter Period | | $R_I$ = 26kΩ, $V_{FB} \geq V_N$ | 3.9 | 4.4 | 4.9 | ms |
| $t_{hop-3}$ | Jitter period | | $R_I$ = 26kΩ, $V_{FB} = V_G$ | 10.2 | 11.5 | 12.8 | ms |
| $f_{OSC-G}$ | Green-mode Minimum Frequency | | $R_I$ = 26kΩ | 18.0 | 22.5 | 25.0 | kHz |
| $V_{FB-N}$ | FB Pin Frequency Reduction Threshold | Pin, FB voltage | $R_I$ = 26kΩ, $V_{FB} = V_N$ | 1.9 | 2.1 | 2.3 | V |
| | | Jitter Range | | 3.7 | 4.2 | 4.7 | KHz |
| $V_{FB-G}$ | FB Voltage at $f_{OSC-G}$ | Pin, FB voltage | $R_I$ = 26kΩ, $V_{FB} = V_G$ | 1.4 | 1.6 | 1.8 | V |
| | | Jitter Range | | 1.27 | 1.45 | 1.62 | KHz |
| $S_G$ | Slope for Green-Mode Modulation | | $R_I$ = 26kΩ | | 85 | | Hz/mV |
| $f_{DV}$ | Frequency Variation vs. $V_{DD}$ Deviation | | $V_{DD}$ = 11.5V to 20V | | | 5 | % |
| $f_{DT}$ | Frequency Variation vs. Temperature Deviation | | $T_A$ = -30 to 85°C | | 1.5 | 5.0 | % |

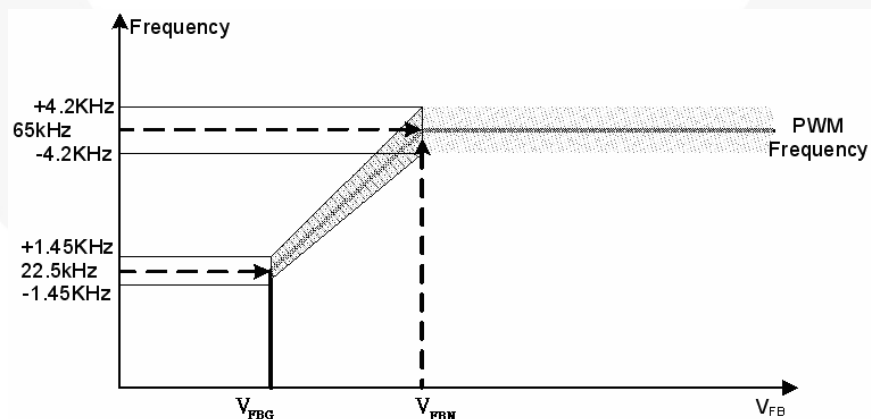*Continued on following page…*



**Figure 5.   PWM Frequency**

## Electrical Characteristics (Continued)

$V_{DD}$ = 15V, $T_A$ = 25°C, unless noted.

| Symbol | Parameter | Test Condition | Min. | Typ. | Max. | Unit |
|--------|-----------|----------------|------|------|------|------|
| **PWM Output Section** | | | | | | |
| $DCY_{MAX}$ | Maximum Duty Cycle | | 80 | 85 | 90 | % |
| $V_{OL}$ | Output Voltage Low | $V_{DD}$ = 15V, $I_O$ = 50mA | | | 1.5 | V |
| $V_{OH}$ | Output Voltage High | $V_{DD}$ = 12V, $I_O$ = 50mA | 8 | | | V |
| $t_R$ | Rising Time | GATE = 1nF | | 350 | | ns |
| $t_F$ | Falling Time | GATE = 1nF | | 50 | | ns |
| $V_{CLAMP}$ | Gate Output Clamping Voltage | $V_{DD}$ = 20V | | | 18 | V |
| **Over-Temperature Protection (OTP) Section**[1] | | | | | | |
| $I_{RT}$ | Output Current of RT Pin | $R_I$ = 26kΩ | 64 | 70 | 76 | μA |
| $V_{RTTH}$ | Threshold Voltage for OTP | | 1.00 | 1.05 | 1.10 | V |
| $t_{DOTP\text{-}LATCH}$ | Over-Temperature Latch-off Debounce | $R_I$ = 26kΩ | | 100 | | μs |
| $R_{RT\text{-}OFF}$ | Equivalent Impedance of RT for OTP[1] | $R_I$ = 26kΩ | 14 | 15 | 16 | kΩ |
| **$R_I$ Section** | | | | | | |
| $RI_{NOR}$ | $R_I$ Operating Range | | 13 | | 36 | kΩ |
| $RI_{MAX}$ | Maximum $R_I$ Value for Protection | | 10 | | | MΩ |
| $RI_{MIN}$ | Minimum $R_I$ Value for Protection | | | | 6 | kΩ |

**Note:**

1. The relationship between $R_{RT\text{-}OFF}$ and $R_I$ is: $R_{RT\text{-}OFF} = V_{OTP\text{-}LATCH\text{-}OFF} / I_{RT} = V_{RT} / (70\mu A \times 26 / R_I \, (K\Omega))$     (1)

# Typical Performance Characteristics
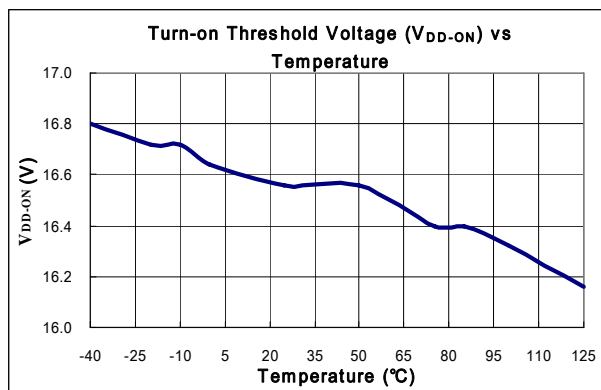
**Turn-on Threshold Voltage (V$_{DD-ON}$) vs Temperature**
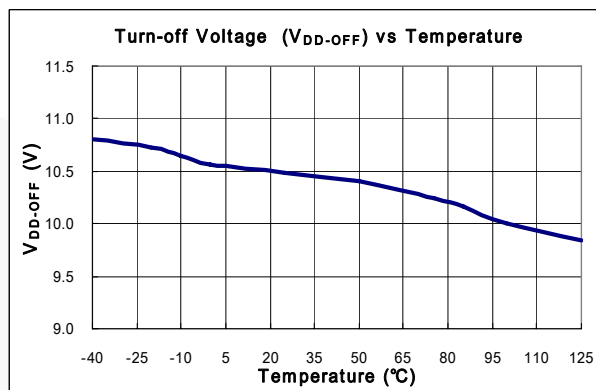
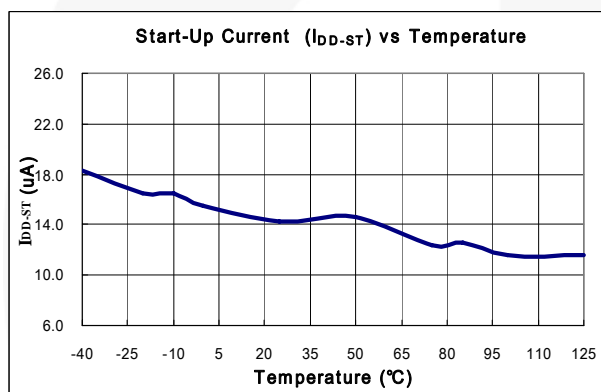Figure 6.   Turn-on Threshold Voltage (V$_{DD-ON}$)
vs. Temperature

**Turn-off Voltage  (V$_{DD-OFF}$) vs Temperature**

Figure 7.   Turn-off Threshold Voltage (V$_{DD-OFF}$)
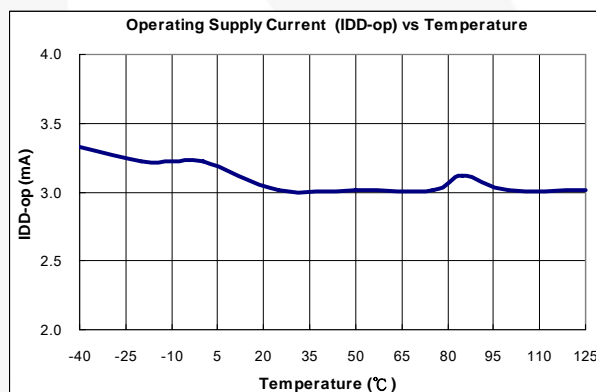vs. Temperature

**Start-Up Current  (I$_{DD-ST}$) vs Temperature**

Figure 8.   Start-up Current (I$_{DD-ST}$) vs. Temperature
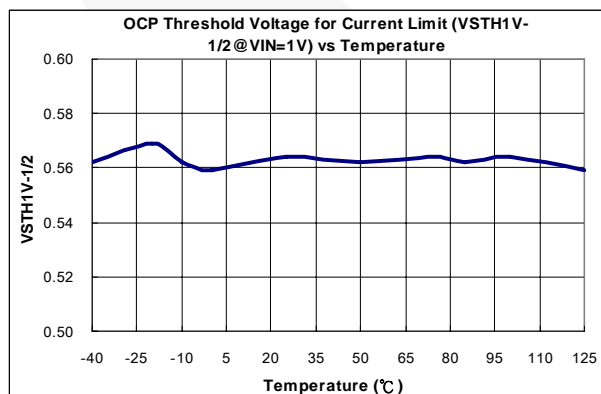
**Operating Supply Current  (IDD-op) vs Temperature**

Figure 9.   Operating Supply Current (I$_{DD-OP}$)
vs. Temperature

**OCP Threshold Voltage for Current Limit (VSTH1V-1/2@VIN=1V) vs Temperature**

Figure 10. OCP Threshold Voltage for Current Limit
(V$_{STH1V}$-$_{1/2}$ at V$_{IN}$ = 1V) vs. Temperature

**OCP Threshold Voltage for Current Limit (VSTH3V-1/2-@VIN=3V) vs Temperature**
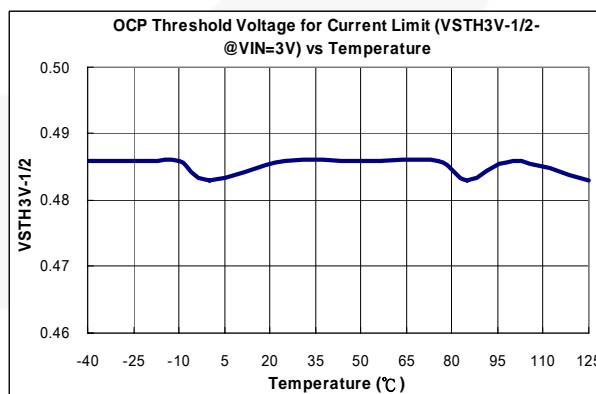
Figure 11. OCP Threshold Voltage for Current Limit
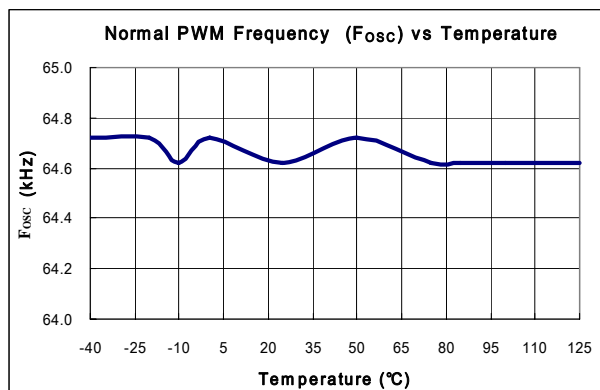(V$_{STH3V}$-$_{1/2}$ at V$_{IN}$ = 3V) vs. Temperature

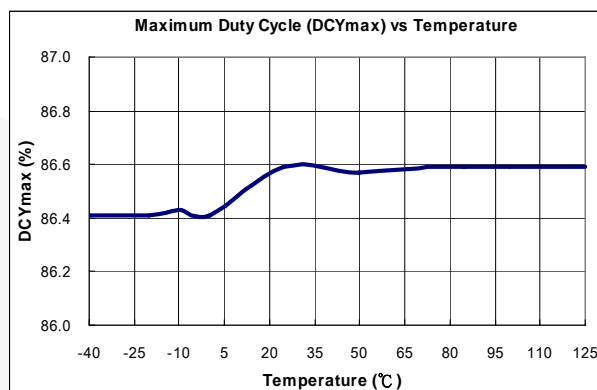Figure 12. Normal PWM Frequency (f$_{OSC}$) vs. Temperature



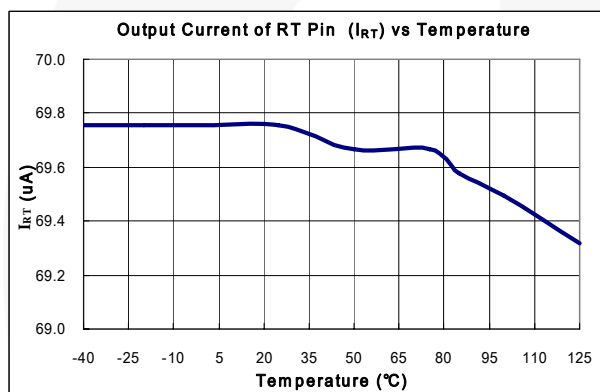Figure 13. Maximum Duty Cycle (DCY$_{MAX}$) vs. Temperature



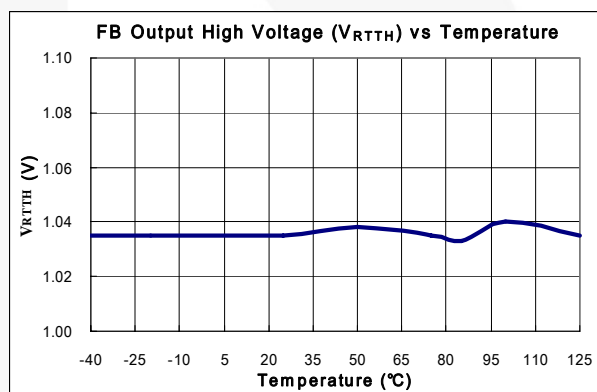Figure 14. Output Current of RT Pin (I$_{RT}$) vs. Temperature



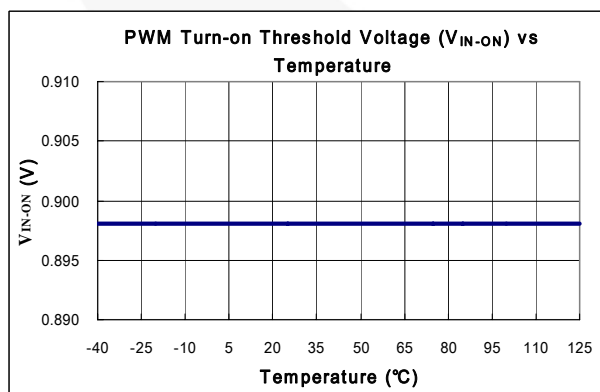Figure 15. FB Output High Voltage (V$_{RTTH}$) vs. Temperature



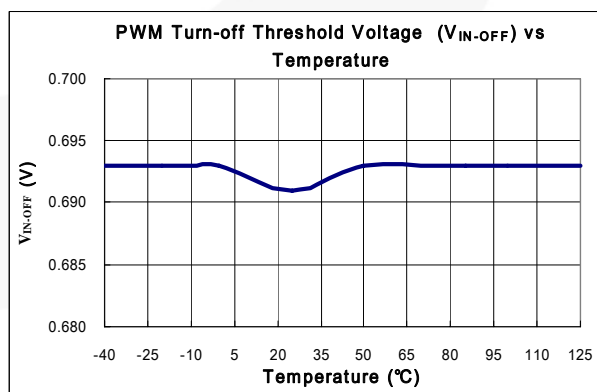Figure 16. PWM Turn-on Threshold Voltage (V$_{IN-ON}$) vs. Temperature



Figure 17. PWM Turn-off Threshold Voltage (V$_{IN-OFF}$) vs. Temperature

## Operation Description

### Start-up Operation

The turn-on/turn-off thresholds are fixed internally at 16.5V/10.5V. To enable the SG6846C during start-up, the hold-up capacitor must first be charged to 16.5V through the start-up resistor.

The hold-up capacitor continues to supply $V_{DD}$ before energy can be delivered from the auxiliary winding of the main transformer. The $V_{DD}$ must not drop below 10.5V during this start-up process. This UVLO hysteresis window ensures that the hold-up capacitor can adequately supply $V_{DD}$ during start-up.

The typical start-up current is only 8μA, which allows a high-resistance, low-wattage start-up resistor to be used to minimize power loss. A 1.5MΩ/0.25W start-up resistor and a 10μF/25V $V_{DD}$ hold-up capacitor are sufficient for a universal input range.

The required operating current has been reduced to 3.7mA, which enables higher efficiency and reduces the $V_{DD}$ hold-up capacitance requirement.

### Green-Mode Operation

The proprietary green-mode function provides off-time modulation to continuously decrease the switching frequency under light-load conditions. Maximum on-time is limited to provide protection against abnormal conditions. To further reduce power consumption under zero-load condition, the PWM oscillator is completely turned off and the power supply enters burst-mode. This green-mode function dramatically reduces power consumption under light-load and zero-load conditions. Power supplies using the SG6846C can meet even the most restrictive international regulations regarding standby power consumption.

### Oscillator Operation

A resistor connected from the RI pin to GND generates a reference current source, inside the SG6846C, used to determine the PWM frequency. Increasing the resistance decreases the amplitude of the current source and reduces the PWM frequency. Using a 26kΩ resistor results in a corresponding 65kHz switching frequency. The relationship between $R_I$ and the switching frequency is:

$$f_{PWM}(kHz) = \frac{1690}{R_I\ (k\Omega)} \tag{2}$$

If an open-circuit or short-circuit to ground occurs at the RI pin, the internal protection circuit immediately shuts down the controller.

### Two-level Over-current Protection (OCP)

The cycle-by-cycle current limiting shuts down the PWM immediately when the switching current is over the peak-current threshold. Additionally, when the switching current is higher than half of the peak-current threshold, the internal counter counts down. When the total accumulated counting time is more than ~110ms ($R_I$ = 26kΩ), the controller is latched off and the internal counter counts up. When the switching current is lower than half of the peak current threshold, the internal counter will count down. When the total accumulated counting time is more than ~110ms ($R_I$ = 26kΩ), the controller is latched off.

This two-level OCP protection and up/down counter are especially designed for SMPS with surge current output, such as those for printers, scanners, and motor drivers.

### Constant Output Power Limit

For constant output power limit over a universal input-voltage range, the peak-current threshold is adjusted by the voltage of the VIN pin. Since the VIN pin is connected to the rectified AC input line voltage through the resistive divider, a higher line voltage generates a higher $V_{IN}$ voltage. The threshold voltage decreases as the $V_{IN}$ increases, making the maximum output power at high line input voltage equal to that at low line input. The value of R-C network should not be so large it affects the power limit (shown in Figure 18). R and C should put on less than 300Ω and 1000pF respectively.

### Brownout Protection

Since the VIN pin is connected through a resistive divider to the rectified AC input line voltage, it can also be used for brownout protection. If the $V_{IN}$ voltage is less than 0.7V, the PWM output is shut off. As the $V_{IN}$ over 0.9V, the PWM output is turned on again. The hysteresis window for ON/OFF is ~0.2V.

### $V_{DD}$ Over-voltage Protection (OVP)

$V_{DD}$ over-voltage protection is built in to prevent damage. When $V_{DD}$ is over 23.6V, the SG6846C is latched off.

### Over-temperature Protection (OTP)

An external NTC thermistor can be connected from the RT pin to GND. The impedance of the NTC decreases at high temperatures. When the voltage of the RT pin drops below 1.05V, the SG6846C is turned off. *For protection-mode options, see Ordering Information.*

## Operation Description (Continued)

### Noise Immunity

Noise from the current sense or the control signal may cause significant pulse-width jitter, particularly in continuous-conduction mode. Slope compensation helps alleviate this problem. Good placement and layout practices should be followed. Avoid long PCB traces and component leads. Compensation and filter components should be located near the SG6846C.
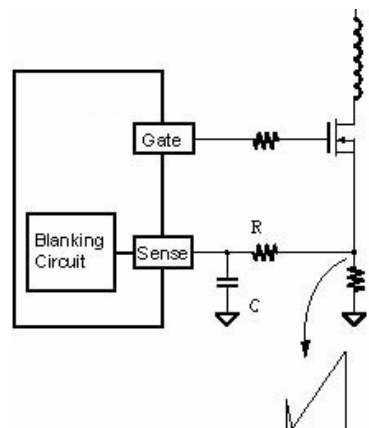


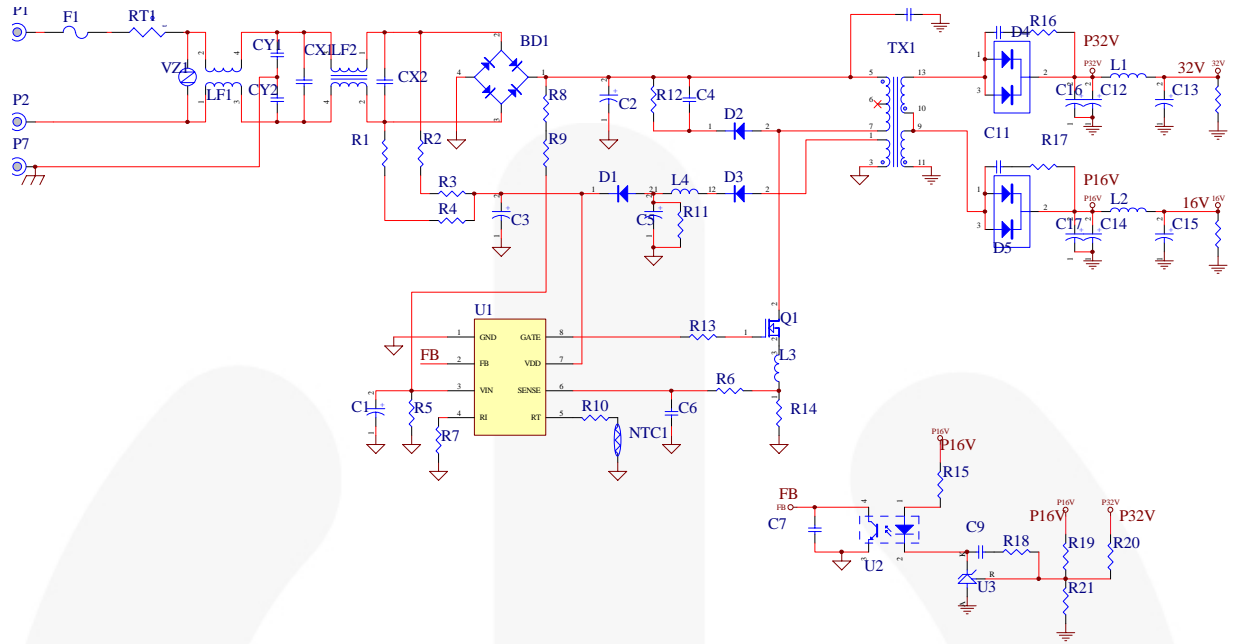**Figure 18. Current Sense R-C Filter**

## Reference Circuit



**Figure 19. Application Circuit for 32V / 16V Output**

## BOM

| Part No. | Value | Part No. | Value | Part No. | Value |
|---|---|---|---|---|---|
| R1, R2, R3, R4 | 470KΩ +/-5% | C4 | 103 P 630V | D3 | FR103 1.0A 200V |
| R8, R9 | S1MΩ +/-1% | C10,C11 | 102 P 1KV | BD1 | DBL406G |
| R5 | 16K2Ω +/-1% | C6,C7 | 102 P 50V | D4 | BYT28-300 |
| R15 | 1K5Ω +/-5% | C9 | 222 P 50V | D5 | BYV32-150 |
| R13 | 10Ω +/-5% | C14,C17 | 470μ 25V | F1 | 250V4A QUICK |
| R18 | 4K7Ω +/-5% | C15 | 220μ 25V | L1,L2 | 1.8μH |
| R21 | 15KΩ +/-1% | C13,C16 | 220μ 50V | L4 | 10μH |
| R7 | 27KΩ +/-5% | C2 | 150μ 400V | U3 | TL431 +/-1% |
| R6 | 330Ω +/-1% | C1 | 4μ7 50V | U1 | SG 6846 |
| R19 | 102KΩ +/-1% | C3 | 10μ 50V | U2 | PC817 |
| R14 | 0Ω22 +/-5% | CX1 | X1 0.47μ 275V | Q1 | 7NB60 |
| R16, R17 | 1W 20Ω +/-5% | C8 | Y2 222P 250V | TX1 | EI-33 |
| R11 | 20KΩ +/-5% | C5 | 100μ 50V | RT1 | SCK053 |
| R12 | 100KΩ +/-5% | CX2 | X2 0.1μF 275V | VZ1 | 14ψ 470V |
| R20 | 887KΩ +/-1% | D1 | 1N4148 | | |
| R22 | 10KΩ +/-1% | D2 | BYV95C | | |

## Physical Dimensions
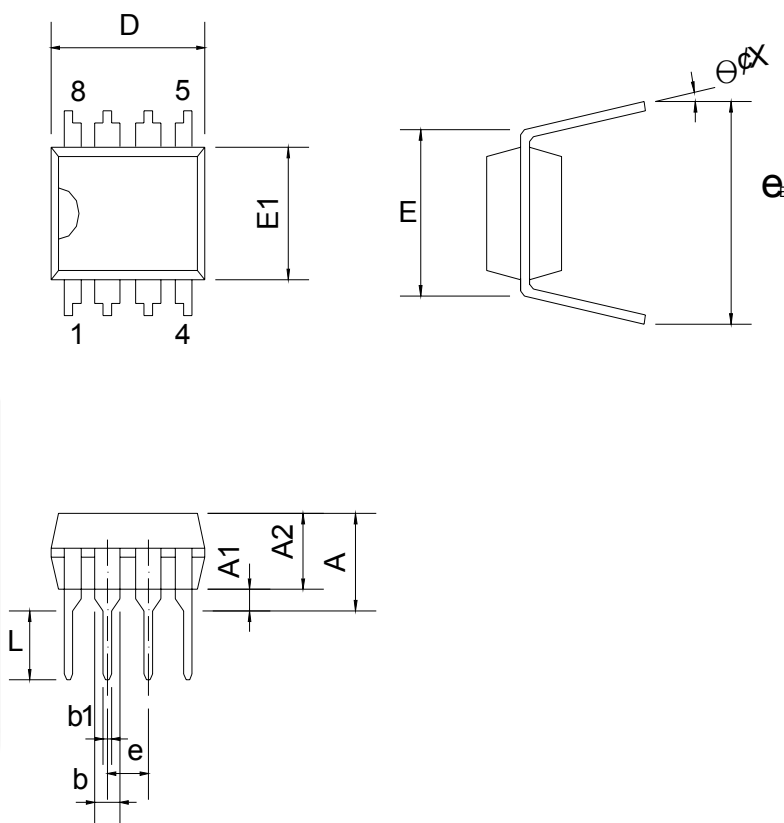
**Figure 20. 8-Pin DIP**

| Symbol | Millimeter | | | Inch | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 5.334 | | | 0.210 |
| A1 | 0.381 | | | 0.015 | | |
| A2 | 3.175 | 3.302 | 3.429 | 0.125 | 0.130 | 0.135 |
| b | | 1.524 | | | 0.060 | |
| b1 | | 0.457 | | | 0.018 | |
| D | 9.017 | 9.271 | 10.160 | 0.355 | 0.365 | 0.400 |
| E | | 7.620 | | | 0.300 | |
| E1 | 6.223 | 6.350 | 6.477 | 0.245 | 0.250 | 0.255 |
| e | | 2.540 | | | 0.100 | |
| L | 2.921 | 3.302 | 3.810 | 0.115 | 0.130 | 0.150 |
| eB | 8.509 | 9.017 | 9.525 | 0.335 | 0.355 | 0.375 |
| $\theta$ ° | 0° | 7° | 15° | 0° | 7° | 15° |

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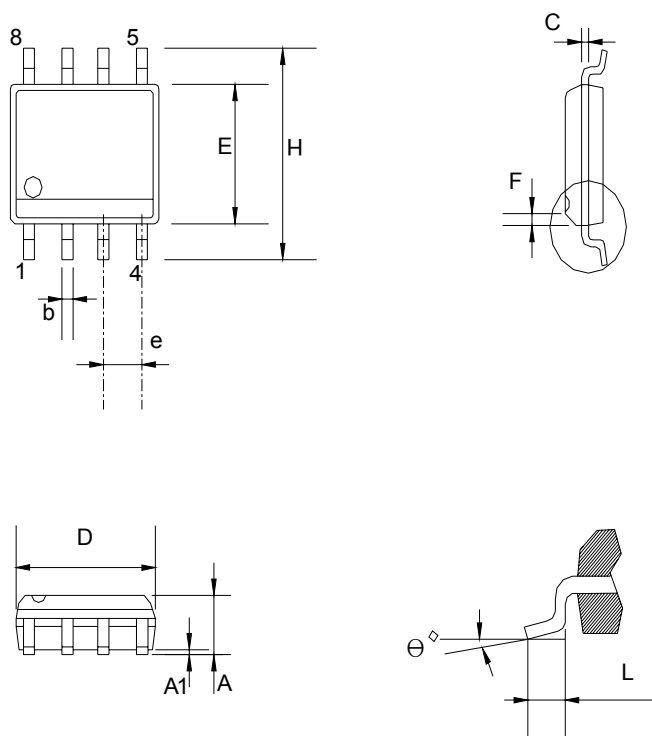*Always visit Fairchild Semiconductor's online packaging area for the most recent package drawings:*
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## Physical Dimensions

**Figure 21. 8-Pin SOP**

| Symbol | Millimeter | | | Inch | | |
|--------|------|------|------|------|------|------|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | 1.346 | | 1.752 | 0.053 | | 0.069 |
| A1 | 0.101 | | 0.254 | 0.004 | | 0.010 |
| b | | 0.406 | | | 0.016 | |
| c | | 0.203 | | | 0.008 | |
| D | 4.648 | | 4.978 | 0.183 | | 0.196 |
| E | 3.810 | | 3.987 | 0.150 | | 0.157 |
| e | 1.016 | 1.270 | 1.524 | 0.040 | 0.050 | 0.060 |
| F | | 0.381X45° | | | 0.015X45° | |
| H | 5.791 | | 6.197 | 0.228 | | 0.244 |
| L | 0.406 | | 1.270 | 0.016 | | 0.050 |
| θ° | 0° | | 8° | 0° | | 8° |

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