

# FAN6103

## Power Supply Supervisor Plus PWM

### Features

- PC Half-Bridge Power Supply Supervisor Plus PWM
- High Integration, Few External Components
- Over-Voltage Protection for 3.3V, 5V, and 12V
- Under-Voltage Protection for 3.3V, 5V, and 12V
- Under-Voltage protection for -12V and/or -5V
- Over-Power and Short-Circuit Protection
- Power-Down Warning Circuitry
- Power-Good Circuitry
- Delay Time for PSON and PG Signal
- Remote ON/OFF Function
- On-Chip Oscillator and Error Amplifier
- Latching PWM for Cycle-By-Cycle Switching
- Push-Pull PWM Operation and Totem-Pole Outputs
- Soft-Start and Maximum 93% Duty Cycle

### Description

FAN6103 controller is designed for switching mode power supply for desktop PCs. It provides all the functions necessary to monitor and control the output of the power supply. Remote ON/OFF control, power good circuitry, and protection features against over-voltage and over-power are implemented. It directly senses all the output rails for OVP without the need of external dividers. An innovated AC-signal sampling circuitry provides a sufficient power-down warning signal for PG.


A built-in timer generates accuracy timing for control circuit, including the PS-off delay. The cycle-by-cycle PWM switching prevents the power transformer from saturation and ensures the fastest response for the short-circuit protection, which greatly reduces the stress for power transistors.

Utilizing minimum external components, the FAN6103 includes all of the functions for push-pull and/or half-bridge topology, decreasing the production cost and PCB space, while increasing the mean time between failures for power supply

### Applications

- Desktop PC Power Supply

### Ordering Information

Part Number	Operating Temperature Range	 Eco Status	Package	Packing Method
FAN6103NZ	-40°C to +105°C	RoHS	16-Pin Dual Inline Package (DIP)	Tube

 For Fairchild's definition of Eco Status, please visit: [http://www.fairchildsemi.com/company/green/rohs\\_green.html](http://www.fairchildsemi.com/company/green/rohs_green.html).

Application Diagram

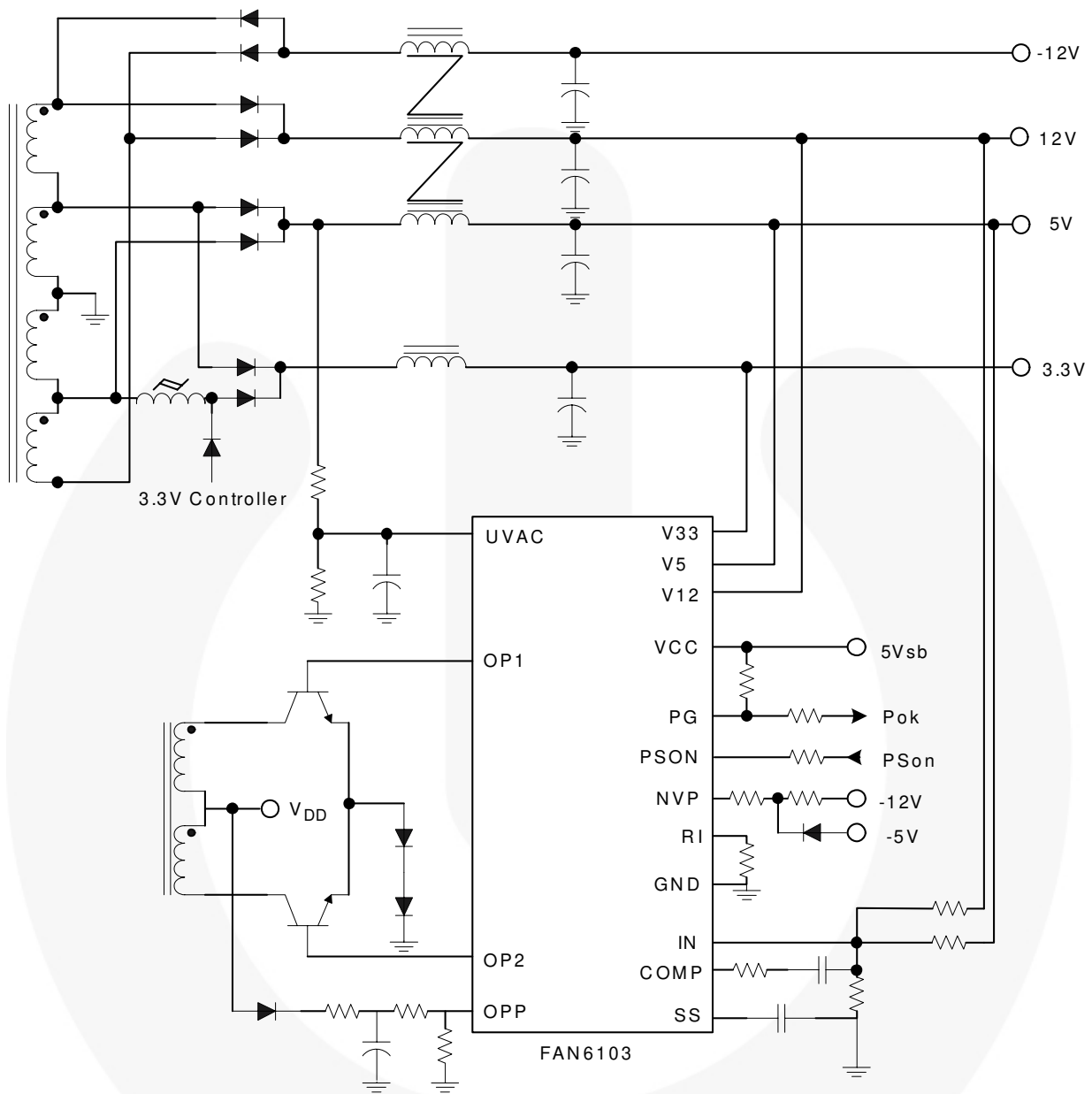


Figure 1. Typical Application

**Block Diagram**

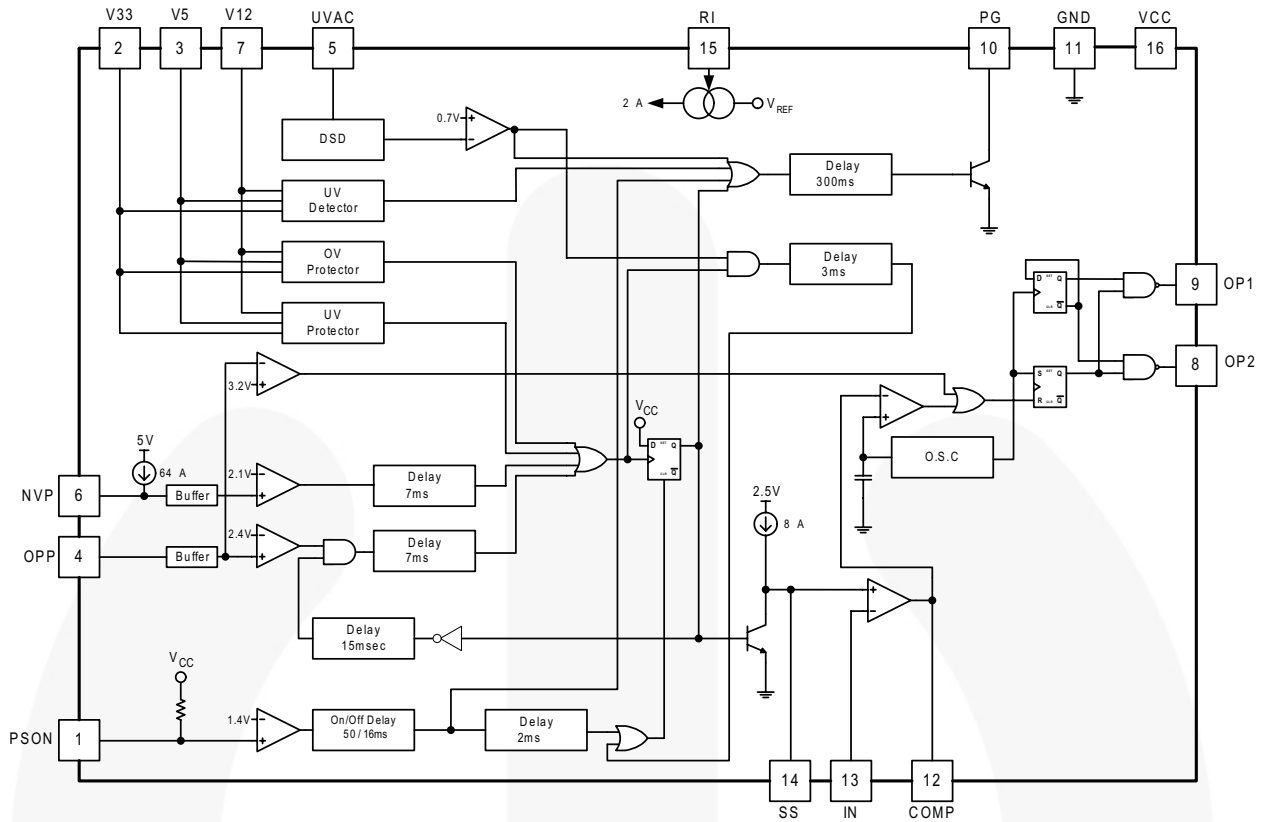
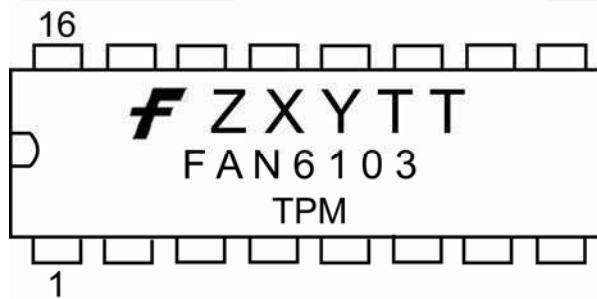


Figure 2. Function Block Diagram

**Marking Information**



- F** – Fairchild Logo
- Z** – Plant Code
- X** – 1-Digit Year Code
- Y** – 1-Digit Week Code
- TT** – 2 -Digit Die Run Code
- T** – Package Type (N:DIP)
- P** – Z: Pb Free
- M** – Manufacture Flow Code

Figure 3. Top Mark

## Pin Configuration

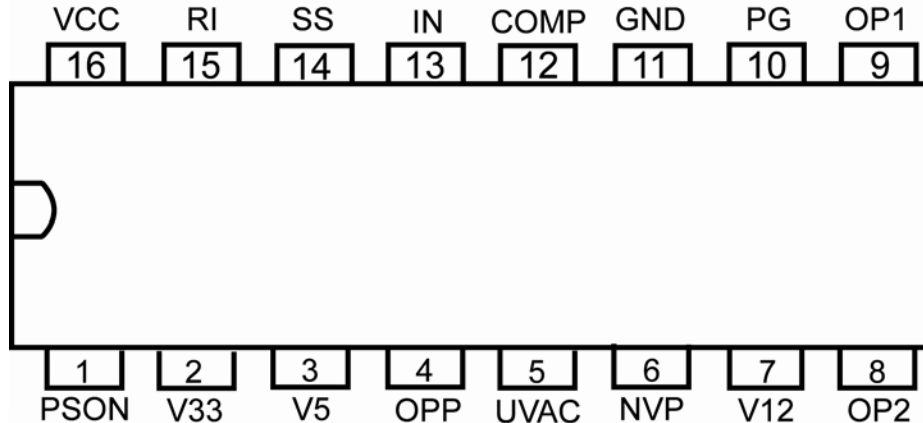


Figure 4. Pin Configuration

## Pin Definitions

Pin #	Name	Description
1	PSON	<b>Remote on/off logic input.</b> Turn on/off the PWM output after the 16ms / 50ms delay. PSON = 0 means that the main SMPS is operational. PSON = 1 means that the main SMPS is off and the latch is reset.
2	V33	<b>3.3V over-voltage/under-voltage control sense input.</b>
3	V5	<b>5V over-voltage/under-voltage control sense input.</b>
4	OPP	<b>Over-power sense input.</b> This pin is connected to driver transformer or the output of current transformer. When not in use, this pin should be grounded.
5	UVAC	<b>AC-fail detection.</b> Detect main AC voltage under-voltage or failure.
6	NVP	<b>The protection input for negative output,</b> such as -12V and/or -5V; trip voltage = 2.1V.
7	V12	<b>12V over-voltage/under-voltage control sense input.</b>
8	OP2	<b>The totem-pole output drivers of push-pull PWM.</b> The output are enabled (LOW) only when the NAND gate inputs are HIGH; the maximum duty cycle on output OP2 is 46%.
9	OP1	<b>The totem-pole output drivers of push-pull PWM.</b> The output are enabled (LOW) only when the NAND gate inputs are HIGH the maximum duty cycle on output OP1 is 46%.
10	PG	<b>Power-good logic output, 0 or 1 (open-collector).</b> PG = 1 means that the power is ready for operation. The PG delay is 300ms.
11	GND	<b>Ground.</b>
12	COMP	<b>Error amplifier output and the input of the PWM comparator.</b>
13	IN	<b>The negative input of error amplifier.</b> The positive input of error amplifier is a 2.5V reference voltage.
14	SS	<b>The soft-start,</b> it is settable through an external capacitor. The current source output at this pin is 8 $\mu$ A and the voltage is clamped at 2.5V.
15	RI	<b>Reference Resistor.</b> Connected to external resistor for the reference setting.
16	VCC	<b>Supply voltage;</b> 4.5V ~ 5.5V, connected to 5V standby.

## Absolute Maximum Ratings

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

Symbol	Parameter		Min.	Max.	Unit
V <sub>CC</sub>	DC Supply Voltage			16	V
V <sub>H</sub>	Supply Voltage on PSON, V33, V5, V12, OP1, OP2 Pins		-0.3	16.0	V
V <sub>L</sub>	Supply Voltage on OPP, UVAC, RI, SS, NVP, IN, COMP, PG Pins		-0.3	7.0	V
I <sub>OUT</sub>	Output Current at PG			30	mA
P <sub>D</sub>	Power Dissipation T <sub>A</sub> < 50°C			1500	mW
Θ <sub>JA</sub>	Thermal Resistance (Junction-to-Air)			82.5	°C/W
T <sub>J</sub>	Operating Junction Temperature		-40	+125	°C
T <sub>STG</sub>	Storage Temperature Range		-55	+150	°C
T <sub>L</sub>	Lead Temperature (Soldering)			+260	°C
ESD	Electrostatic Discharge Capability	Human Body Model, JESD22-A114		3000	V
		Charged Device Model, JESD22-C101		1250	

### Notes:

- All voltage values, except differential voltage, are given with respect to GND pin.
- Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device.

## 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 <sub>A</sub>	Operating Ambient Temperature	-40	+105	°C

## Electrical Characteristics

$V_{CC} = 5V$ ,  $T_A = 25^\circ C$ , and  $R_I = 75k\Omega$  unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>V<sub>CC</sub> Section</b>						
$V_{CC}$	DC Supply Voltage		4.5		5.5	V
$I_{CC1}$	Total Supply Current	PSON = LOW, OP1/OP2 = 1000pF			10	mA
$I_{CC2}$	Total Supply Current	PSON = HIGH, OP1/OP2 = 1000pF		5	10	mA
<b>Protection Section</b>						
$V_{OVP}$	Over-Voltage Protection	3.3V	3.9	4.1	4.3	V
		5.0V	5.8	6.1	6.5	V
		12.0V	13.9	14.5	14.9	V
$V_{UVP}$	Under-Voltage Protection	3.3V	2.0	2.6	2.8	V
		5.0V	3.0	3.6	3.9	V
		12.0V	6.0	7.2	8.0	V
$V_{UVS}$	Under-Voltage Sense for PG Low	3.3V	2.5	2.8	3.0	V
		5.0V	4.0	4.3	4.5	V
		12.0V	9.4	10.1	10.4	V
$V_{OPP}$	Over-Power Protection (with $T_{OPP}$ Delay Time) <sup>(3)</sup>	$V_{UVAC} = 1.5V$	2.25	2.32	2.39	V
$V_{OPPH}$	Over-Power Protection (without Delay Time)		3.0	3.2	3.4	V
$V_X$	Disable Under-Voltage / Over- Power Protection Threshold		0.2	0.3	0.4	V
$V_{NVP}$	Negative Voltage Protection Voltage Level		2.0	2.1	2.2	V
$I_{NVP}$	Negative Voltage Protection Source Current		63	67	71	$\mu A$
$T_{OVP}$	Timing for Over-Voltage Protection		0.37	0.70	1.35	ms
$T_{UVP}$	Timing for Under-Voltage Protection		0.80	2.40	3.75	ms
$T_{UVS}$	Timing for Under-Voltage Sense for PG Low		0.37	1.20	1.88	ms
$T_{OPP}$	Timing for Over-Power Protection		5	7	9	ms
$T_{NVP}$	Timing for Negative Voltage Protection		3.3	7.0	10.2	ms
<b>PWM Output Section</b>						
$V_{OL}$	Output Voltage Low				0.8	V
$V_{OH}$	Output Voltage High		4			V
$R_O$	Output Impedance of $V_{OH}$		1.5		3.3	k $\Omega$

**Note:**

3.  $V_{OPPS} = (2/3) \cdot V_{OPP} + (1/3) \cdot V_{UVAC}$ .

*Continued on following page...*

**Electrical Characteristics** (Continued)

$V_{CC} = 5V$ ,  $T_A = 25^\circ C$ , and  $R_I = 75k\Omega$  unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
<b>Power-Good Section</b>						
$t_{PG}$	Timing for PG Delay	$R_I = 75k\Omega$	200	300	400	ms
$V_{UVAC}$	UVAC Voltage Sense for PG		0.68	0.70	0.72	V
$t_R$	PG Good Output Rising Time	$C_L = 100pF$ , Pull 2.25V to 5.00V		1	3	$\mu s$
$t_F$	PG Good Falling Time	$C_L = 100pF$ , Pull to 5.00V to 2.25V		300	500	ns
$V_{OL2}$	PG Output Saturation Level	$I_{PG} = 10mA$			0.5	V
$I_{ON2}$	PG Leakage Current Collector	$V_{PG} = 5V$			1	$\mu A$
<b>Remote ON/OFF Section</b>						
$V_{IH}$	High-Level Input Voltage		2			V
$V_{IL}$	Low-Level Input Voltage				0.8	V
$V_{HYSTERESIS}$	PSON Input Hysteresis Voltage		0.3			V
$I_{PSON}$	Remote Input Driving Current				0.5	mA
$t_{PSON(ON)}$	Timing PSON to ON	$R_I = 75k\Omega$	38	50	62	ms
$t_{PSON(OFF)}$	Timing PSON to OFF	$R_I = 75k\Omega$	8	16	24	ms
$t_{PSOFF}$	Timing PG LOW to Power OFF	$R_I = 75k\Omega$	1.5	2.0	6.3	ms
<b>Error Amplifier Section</b>						
$V_{REF}$	Reference Voltage	$T_A = 25^\circ C$	2.46	2.50	2.54	V
$I_{IB}$	Input Bias Current				0.1	$\mu A$
$A_{VOL}$	Open-Loop Voltage Gain		50	60		dB
BW	Unity Gain Bandwidth		0.3	1.0		MHz
PSRR	Power Supply Rejection Ratio		50			dB
<b>Oscillator Section</b>						
$f_{OSC}$	PWM Frequency	$R_I = 75k\Omega$	62	65	68	kHz
$DC_{MAX}$	Max Duty Cycle		85		93	%
<b>Soft-Start Section</b>						
$I_{SS}$	Charge Current		7	8	9	$\mu A$

## Typical Performance Characteristics

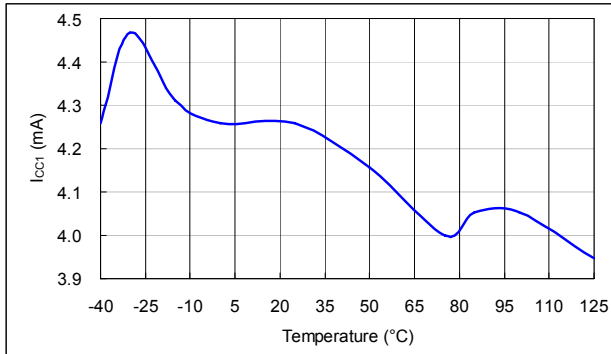


Figure 5. Operating Supply Current vs. Temperature

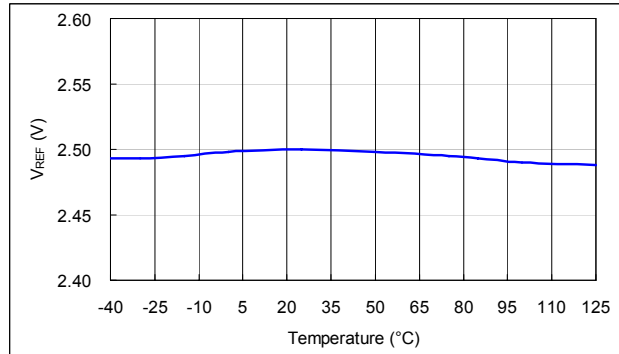


Figure 6. Reference Voltage vs. Temperature

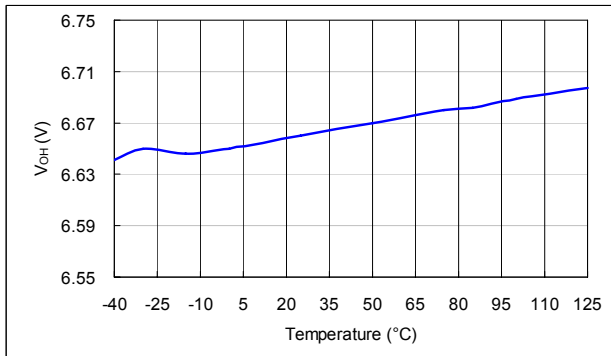


Figure 7. PWM Output Voltage vs. Temperature

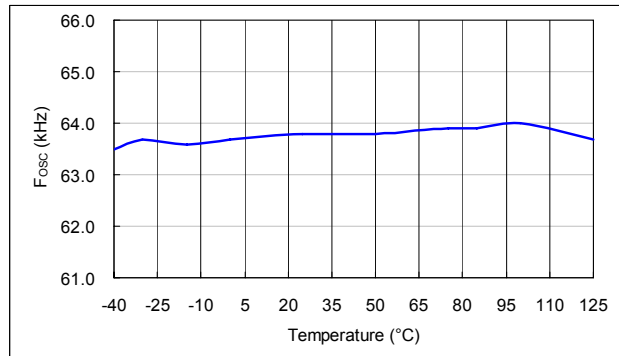


Figure 8. Frequency vs. Temperature

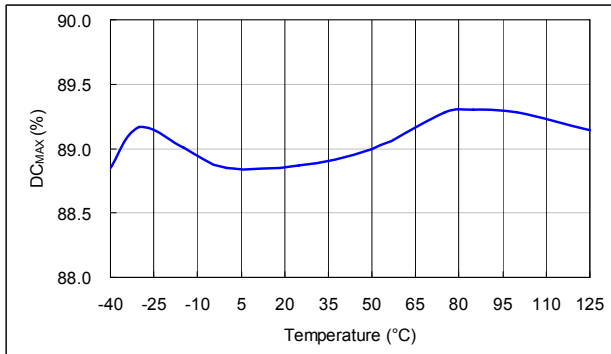


Figure 9. Maximum Duty Cycle vs. Temperature

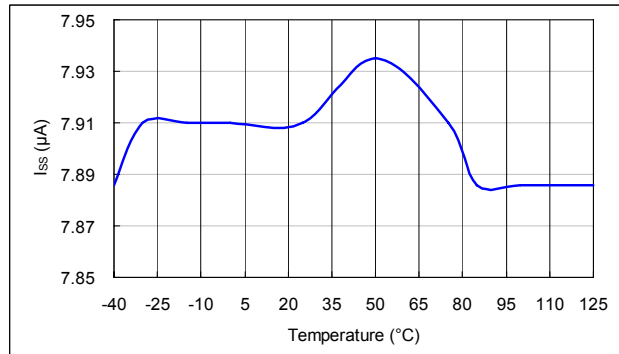
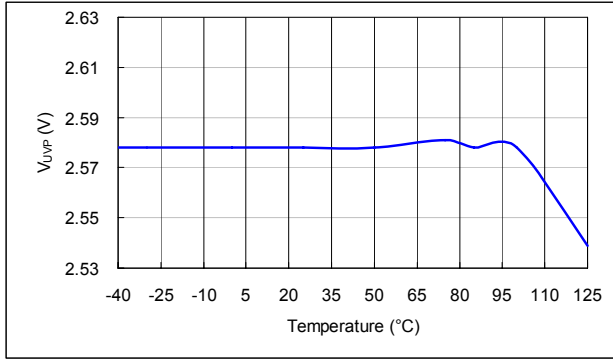


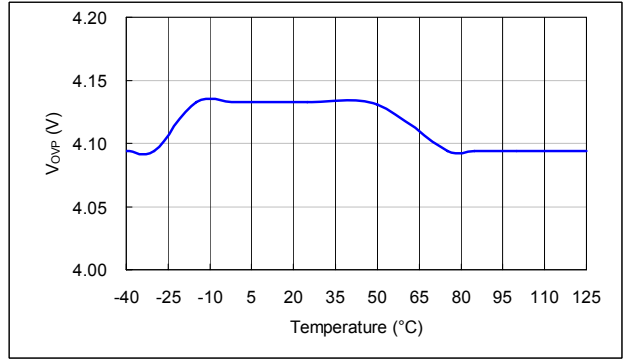
Figure 10. Charge Current vs. Temperature



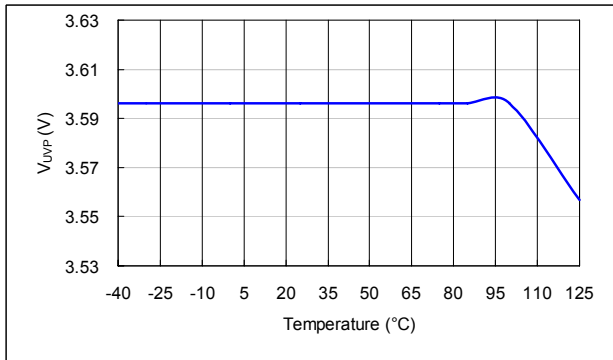
**Typical Performance Characteristics (Continued)**



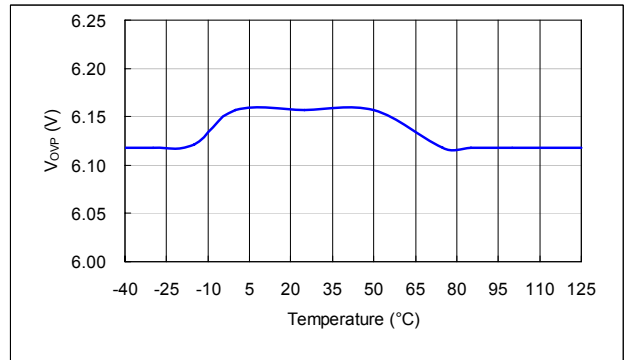
**Figure 11. 3.3V V<sub>UVP</sub> vs. Temperature**



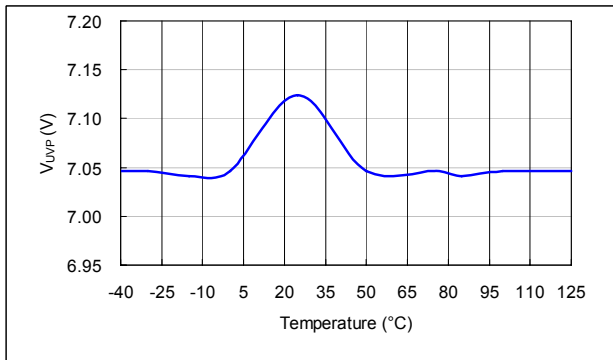
**Figure 12. 3.3V V<sub>OVP</sub> vs. Temperature**



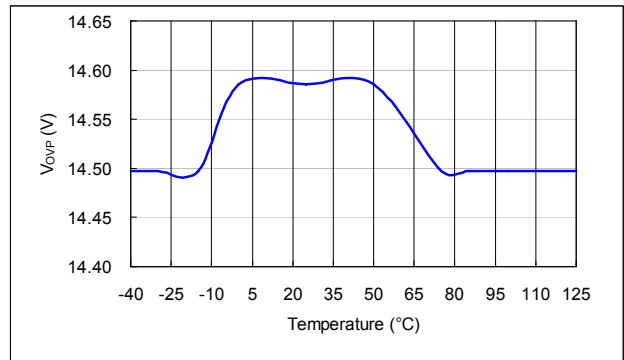
**Figure 13. 5V V<sub>UVP</sub> vs. Temperature**



**Figure 14. 5V V<sub>OVP</sub> vs. Temperature**



**Figure 15. 12V V<sub>UVP</sub> vs. Temperature**



**Figure 16. 12V V<sub>OVP</sub> vs. Temperature**

## Functional Description

FAN6103 is suitable for half-bridge, push-pull topology and incorporates with a three-channel supervisor. The PWM section comprises a built-in 65KHz oscillator and high-immunity circuits, which protect the system from noise interference and provide more noise margins. FAN6103 has OVP and UVP for 12V, 5V, and 3.3V. NVP is used for negative voltage protection, such as -12V and/or -5V. The UVAC is applied to detect AC line condition.

## Over-Power Protection (OPP)

FAN6103 provides over-power protection to detect over-power or short-circuit conditions. When it detects the voltage level over 2.4V, the supervisor triggers PG to LOW and pulls the SS pin LOW to switch off the power.

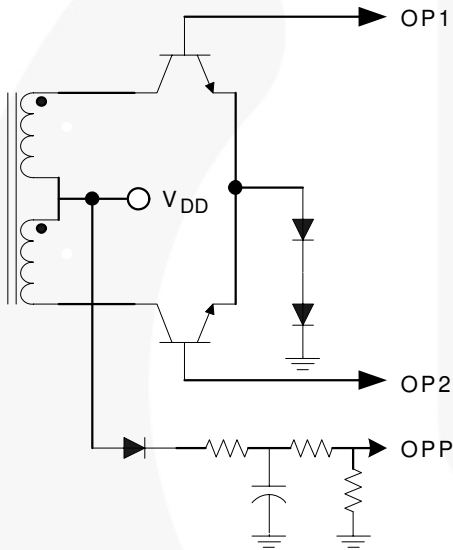


Figure 17. OPP Protection Circuit

## Negative-Voltage Protection (NVP)

The NVP provides an under-voltage protection for negative voltage output. An under-voltage represents the phenominal of the overload condition in negative voltage output. For example, the -12V output may drop to -10V during the overload situation. A resistor determining the threshold of the protection is connected from pin NVP to the negative voltage output. Via this resistor, NVP output a 64μA constant current to the negative voltage output. When the NVP voltage is over 2.1V for longer than 7ms, FAN6103 locks the power output off:

$$V_{NVP} = 64\mu A \times (R_1 + R_2) + (-12V) \quad (1)$$

The power outputs are locked off when  $V_{NVP} > 2.1V$ .

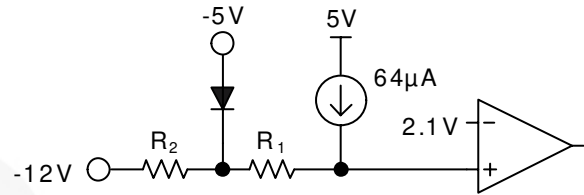


Figure 18. NVP Protection Circuit

## AC-Fail Detection

Through a resistor divider, UVAC is connected to the secondary power transformer for detecting the AC line condition. Once the voltage of UVAC is lower than 0.7V for a period of time, such as 200μs, the PG signal is pulled LOW to indicate an AC line power-down condition. The voltage amplitude of the PWM switching signal in the secondary power transformer is proportional to the AC line voltage. Adjust the ratio of resistor divider to determine the threshold of power-down warning. A small capacitor is connected from UVAC to ground for filtering the switching noise.

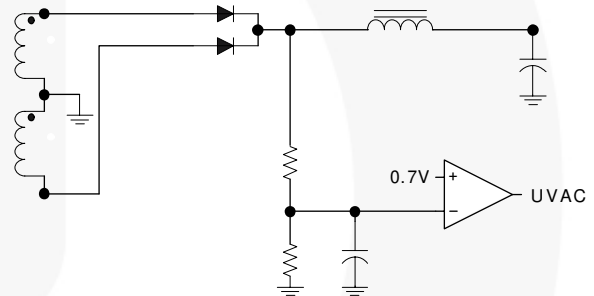


Figure 19. AC Detection Circuit

# Timing Chart

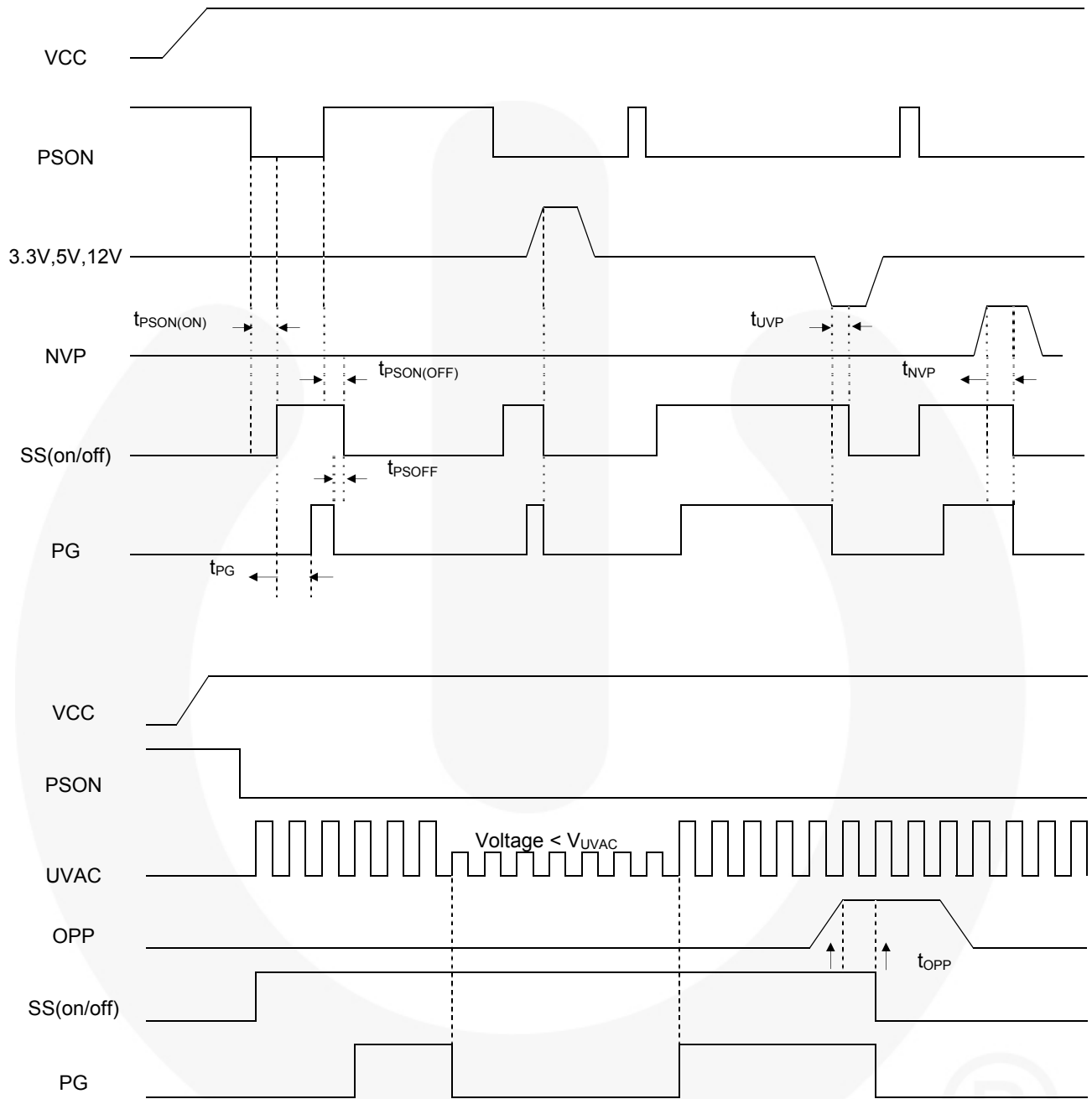
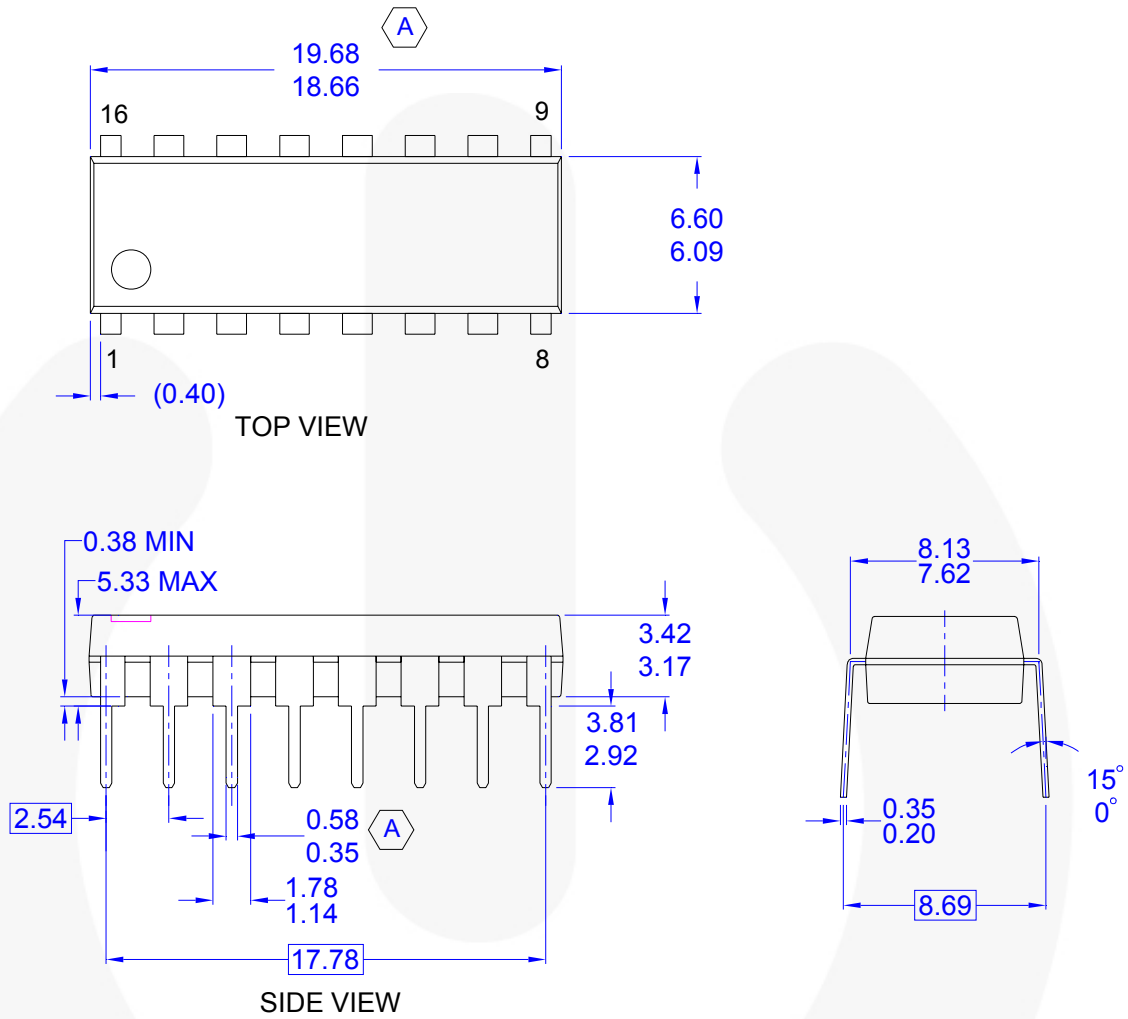


Figure 20. Timing Diagram

Physical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO JEDEC MS-001 VARIATION BB
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR PROTRUSIONS
- D) CONFORMS TO ASME Y14.5M-1994
- E) DRAWING FILE NAME: N16EREV1

Figure 21. 16-Pin Dual In-Line Package (DIP)

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STEALTH™  
SuperFET™  
SuperSOT™-3  
SuperSOT™-6  
SuperSOT™-8  
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SyncFET™  
Sync-Lock™

SYSTEM GENERAL®  
The Power Franchise®  
the power franchise  
TinyBoost™  
TinyBuck™  
TinyCalc™  
TinyLogic®  
TINYOPTO™  
TinyPower™  
TinyPWM™  
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**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.

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