FEATURES

- PC half-bridge (or 494) power supply supervisor + two 431 + 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
- Two shunt regulators for 3.3V and 5V-standby
- Latching PWM for cycle-by-cycle switching
- Push-pull PWM operation and totem pole outputs
- Soft-start and maximum 93% duty cycle

APPLICATIONS

Switching mode power supply for computers:

- AT
- NLX
- SFX (micro-ATX)

DESCRIPTION

SG6105A controller is designed for switching-mode power supplies 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 for external dividers. An innovative AC-signal sampling circuitry provides a sufficient power-down warning signal for PG.
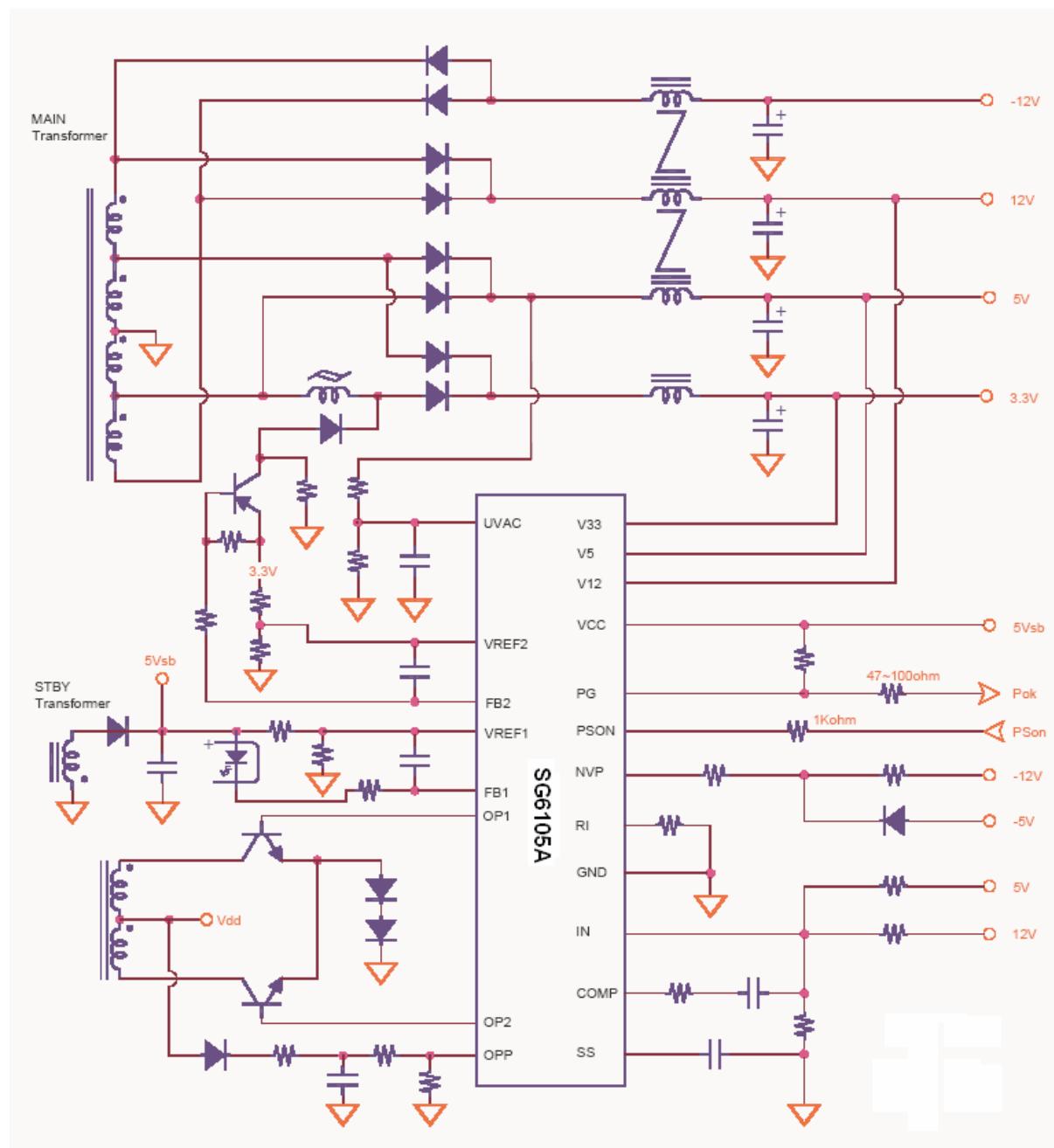
A built-in timer generates accurate timing for the control circuit, including the PS-off delay. The cycle-by-cycle PWM switching prevents the power transformer from saturation and ensures the fastest response for the short-circuit protection, which greatly reduces stress for power transistors. Two internal precision TL431 shunt regulators provide stable reference voltage and a driver for 3.3V and 5V standby regulation.

Utilizing minimum external components, the SG6105A includes the functions for push-pull and/or half-bridge topology, decreasing production cost and PCB space, and increasing the MTBF for power supply.
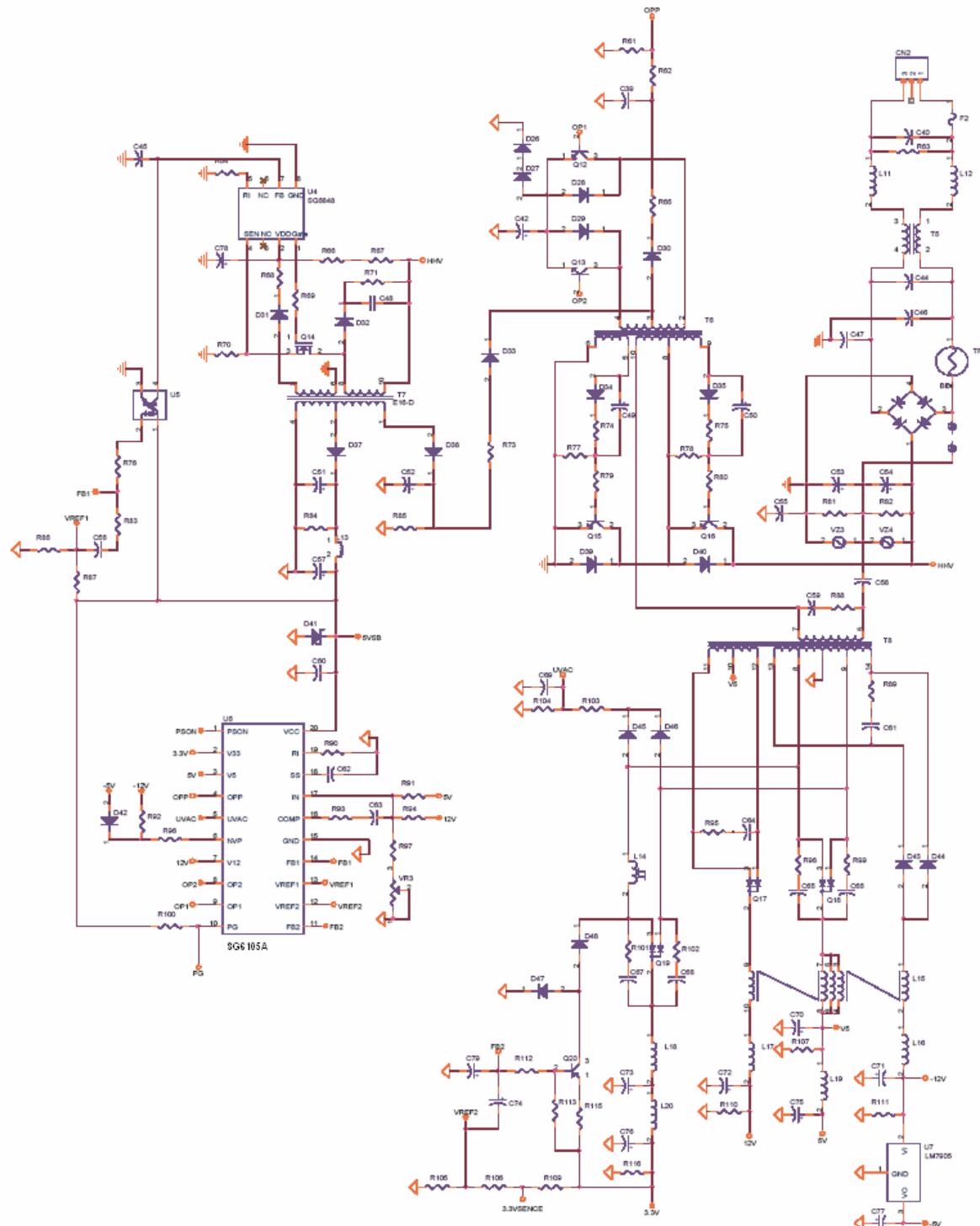
TYPICAL APPLICATION 1
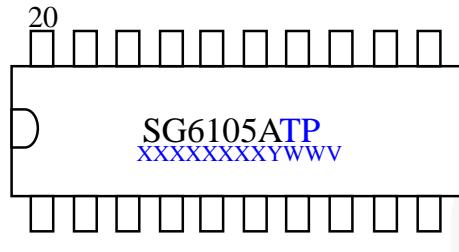
TYPICAL APPLICATION 2

MARKING DIAGRAMS
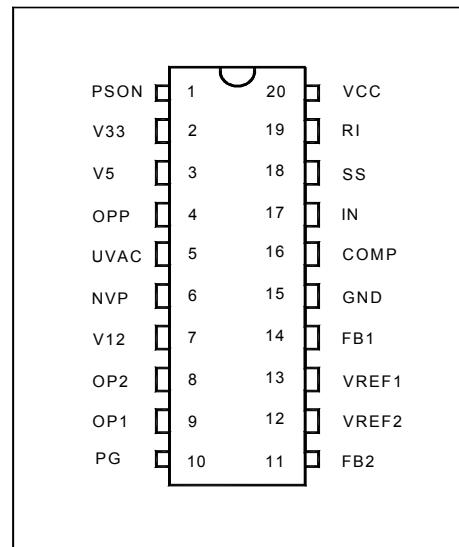
```
20
  ┌─────────────────────────┐
  │                         │
  │      SG6105ATP          │
  │    XXXXXXXXYWWV         │
  │                         │
  └─────────────────────────┘
1
```

T : D = DIP
P : Z = Lead Free
Null=regular package
XXXXXXXX: Wafer Lot
Y: Year; WW: Week
V: Assembly Location

PIN CONFIGURATION

Pin		Pin	
PSON	1	20	VCC
V33	2	19	RI
V5	3	18	SS
OPP	4	17	IN
UVAC	5	16	COMP
NVP	6	15	GND
V12	7	14	FB1
OP2	8	13	VREF1
OP1	9	12	VREF2
PG	10	11	FB2

ORDERING INFORMATION

Part Number	Pb-Free	Package
SG6105ADZ	(leaf)	20-Pin DIP
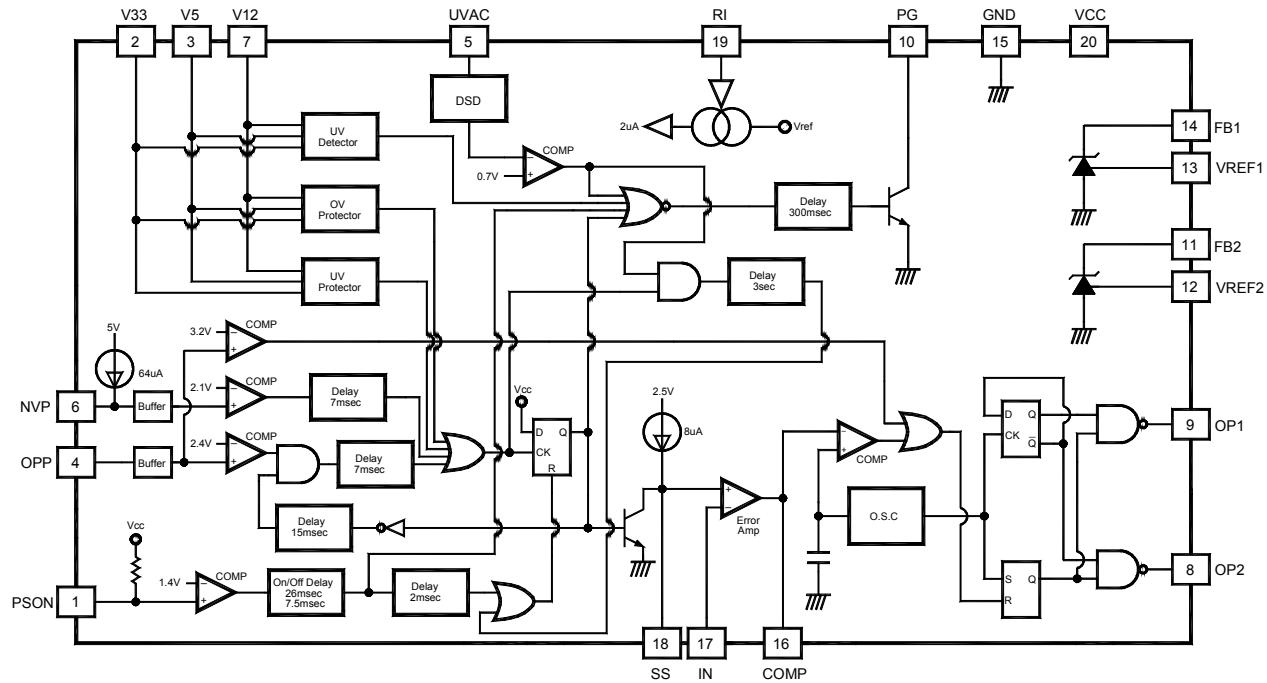
PIN DESCRIPTIONS

Name	Pin	Type	Function
PSON	1	Logic Input	Remote on/off logic input for CPU or controller. Turn on/off the PWM output after the 7.5ms / 26ms delay. PSON = 0, the main SMPS is operational. PSON =1, the main SMPS is off and the latch is reset.
V33	2	Analog Input	3.3V over-voltage/under-voltage control sense input.
V5	3	Analog Input	5V over-voltage/under-voltage control sense input.
OPP	4	Analog Input	Over-power sense input. This pin is connected to driver transformer or the Output of current transformer. When not in use, this pin should be grounded.
UVAC	5	Analog Input	AC fail detection, detect main AC voltage under-voltage and/or failure.
NVP	6	Analog Input	The protection input for negative Output, such as –12V and/or –5V. Trip voltage = 2.1V.
V12	7	Analog Input	12V over-voltage/under-voltage control sense input.
OP1/OP2	9/8	Analog Output	The totem-pole Output drivers of push-pull PWM. The Output are enabled (low) only when the NAND gate inputs are high. The maximum duty cycle on an Output (OP1 or OP2) is 46%.
PG	10	Logic Output	Power-good logic output, 0 or 1 (open-collector). PG = 1, the power is good for operation. The PG delay is 300ms.
FB2	11	Analog Output	Output for second converter regulation loop.
VREF2	12	Analog Input	Reference comparison input for second converter regulation loop, 2.5V.
VREF1	13	Analog Input	Reference comparison input for first converter regulation loop, 2.5V.
FB1	14	Analog Output	Output for first converter regulation loop.
GND	15	Supply	Ground.
COMP	16	Analog Output	Error amplifier Output and the input of the PWM comparator.
IN	17	Analog Input	The negative input of error amplifier. The positive input of error amplifier is a 2.5V reference voltage.
SS	18	Analog Input	The soft-start, settable through an external capacitor. The current source output at this pin is 8µA and the voltage is clamped at 2.5V.
RI	19	Program Analog Input	Connected to external resistor for the reference setting. R_I = 75kΩ.
VCC	20	Supply	Supply voltage. 4.5V ~ 5.5V connected to 5V-standby.
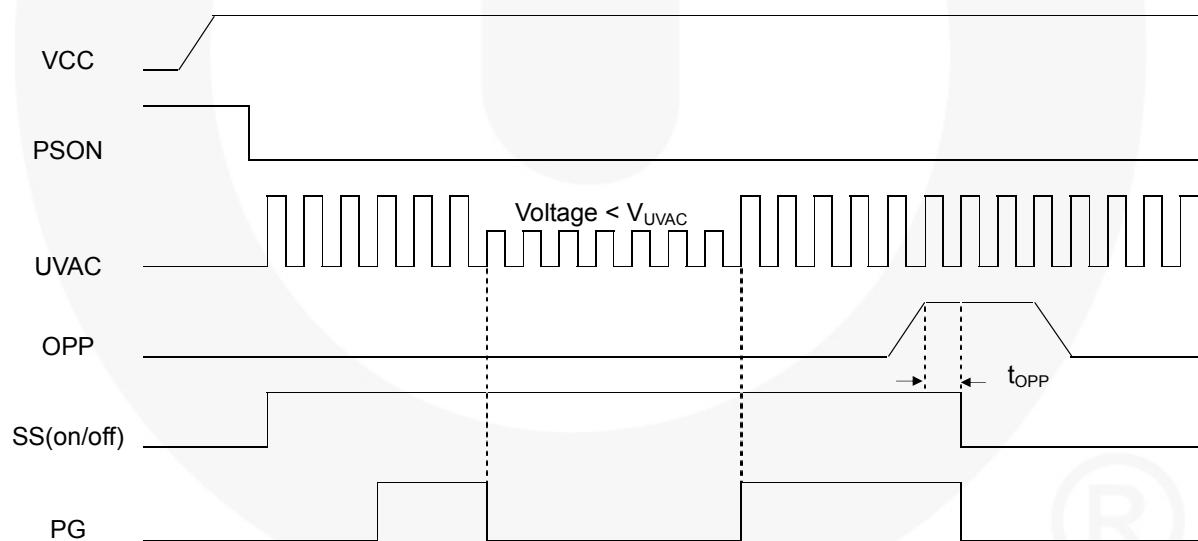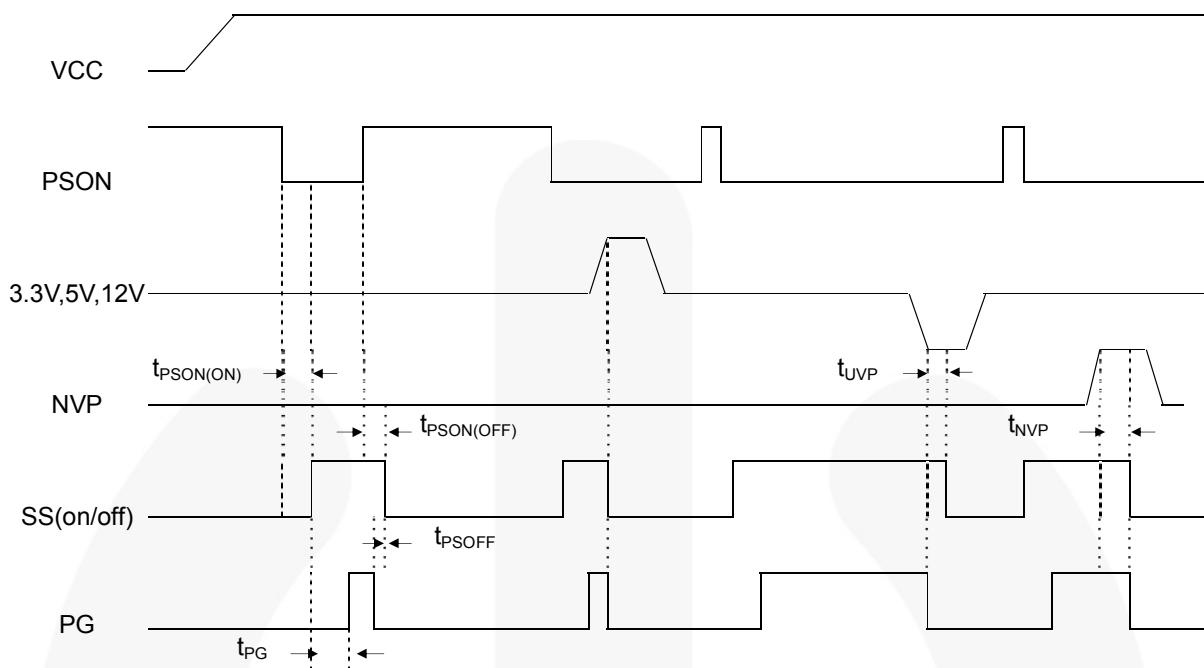
BLOCK DIAGRAM

TIMING DIAGRAM

VCC

PSON

3.3V,5V,12V

$t_{PSON(ON)}$ t_{UVP}

NVP

$t_{PSON(OFF)}$ t_{NVP}

SS(on/off)

t_{PSOFF}

PG

t_{PG}

VCC

PSON

Voltage < V_{UVAC}

UVAC

OPP

t_{OPP}

SS(on/off)

PG

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage at Pin 20	16	V
I_{OUT}	Output Current at PG, Fb1, Fb2 Pins	30	mA
VPIN	V12, OP1, OP2, FB1, FB2, SS	-0.3 to 16	V
	PSON, V33, V5, VREF1, VREF2, OPP, UVAC, RI, NVP, IN, COMP, PG	-0.3 to 7	V
$P_{D,25°C}$	Power Dissipation (T_A=25°C)	1.5	W
$P_{D,90°C}$	Power Dissipation (T_A=90°C)	0.5	W
T_{STG}	Storage Temperature Range	-55 to +150	°C
$R_{θJA}$	Thermal Resistance, Junction-To-Air	82.5	°C /W
$T_{J,MAX}$	Operating Junction Temperature	150	°C
$T_{A,MAX}$	Operating Ambient Temperature	-30 to +125	°C
T_L	Lead Temperature (Soldering, 10 Seconds)	260	°C
ESD	Electrostatic Discharge Capability, Human Body Model	3.0	KV

*   All voltage values, except differential voltages, 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

Symbol	Parameter	Test Condition	Value	Unit
V_{CC}	DC Supply Voltage		4.5 to 5.5	V
V_{FB}	Shunt Regulator Output Fb1, Fb2 Pins		4 to 16	V
T_A	Operating Ambient Temperature Range		-25 to +85	°C

* For proper operation.

ELECTRICAL CHARACTERISTICS

Values are provided for $4.5V \leqq V_{CC} \leqq 5.5V$, T_A = -25°C~+85°C, R_I = 75KΩ, unless noted.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
I_{CC}	Total Supply Current	PG High		5	10	mA
V_{OVP1}	Over-Voltage Protection 3.3V		3.9	4.1	4.3	V
V_{OVP2}	Over-Voltage Protection 5V		5.8	6.1	6.5	V
V_{OVP3}	Over-Voltage Protection 12V		13.9	14.5	14.9	V
V_{UVP1}	Under-Voltage Protection 3.3V		2.0	2.6	2.8	V
V_{UVP2}	Under-Voltage Protection 5V		3.0	3.6	3.9	V
V_{UVP3}	Under-Voltage Protection 12V		6.0	7.2	8.0	V
V_{UVS1}	Under-Voltage Sense 3.3V for PG Low		2.5	2.8	3.0	V
V_{UVS2}	Under-Voltage Sense 5V for PG Low		4.0	4.3	4.5	V
V_{UVS3}	Under-Voltage Sense 12V for PG Low		9.4	10.1	10.4	V
V_{OPP}[*]	Over-Power Protection (With T_{OPP} Delay Time)	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	µA
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

Note *: V_{OPPS} = (2/3) x V_{OPP} + (1/3) x V_{UVAC}.

Shunt Regulator Section Current

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{REF}	Reference Voltage	I_{FB} = 0.5mA, T_A = 25℃	2.475	2.500	2.525	V
$V_{DEV, I}$[**]	Deviation of V_{REF} Over FB Current	I_{FB} = 0.5mA to 10mA			20	mV
$V_{DEV, T}$[**]	Deviation of V_{REF} Over Temperature			10	30	mV
$R_{EGLI-FB}$[**]	Line Regulation	$4 \leq V_{FB} \leq 15V$		1		mV/V
I_{OUT-FB}**	Output Sinking Current Capability	V_{FB} = 2V	10			mA

Note **: Not tested in production.

Power-Good Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
T_{PG}	Timing for PG Delay	R_I = 75kΩ	200	300	400	ms
V_{UVAC}	UVAC Voltage Sense for PG		0.68	0.70	0.72	V
T_R[**]	Power -Good Output Rising Time	C_L = 100pF, Pull 2.2K to 5V		1	3	µs
T_F[**]	Power-Good Falling Time	C_L = 100pF, Pull 2.2K to 5V		300	500	ns
V_{OL2}	Power-Good Output Saturation Level	I_{PG} = 5mA			0.5	V
I_{ON2}	Power-Good Leakage Current Collector	V_{PG} = 5V			1	µA

Note **: Not tested in production.

Remote On/Off Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
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 (PS-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

Error Amplifier Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{2.5}$	Reference Voltage	$T_A = 25°C$	2.46	2.50	2.54	V
I_{IB} [**]	Input Bias Current				0.1	μA
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

Note [**]: Not tested in production.

Oscillator Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
F_{OSC}	PWM Frequency	$R_I = 75k\Omega$	62	65	68	KHz

Soft-Start Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
I_{SS}	Charge Current		7	8	9	μA

Comparator Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
DC	Duty Cycle		85		93	%
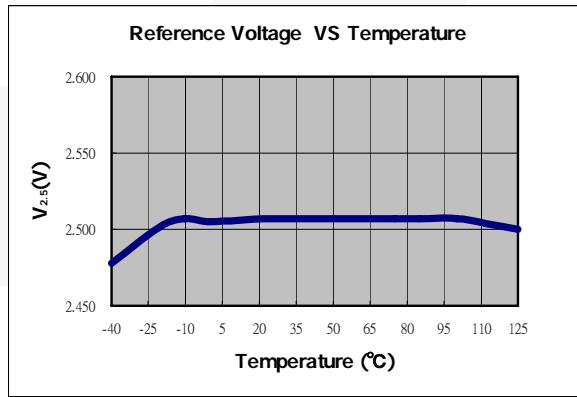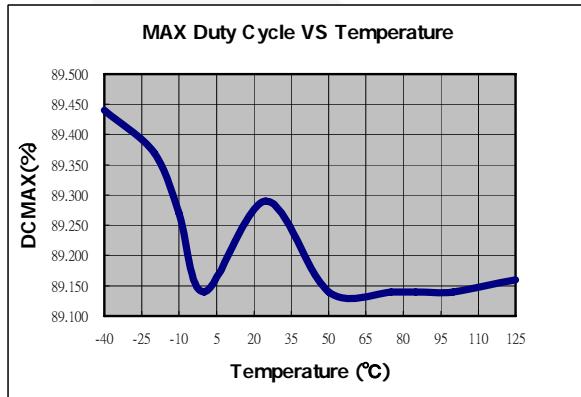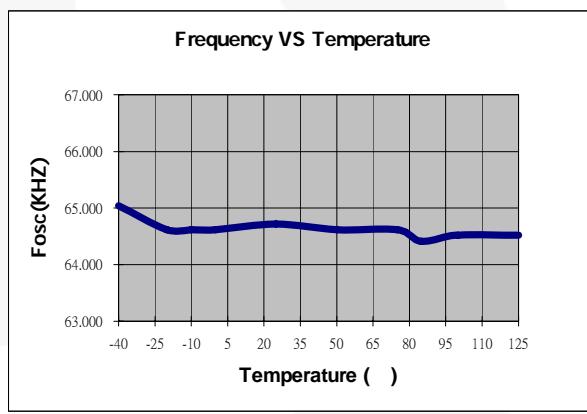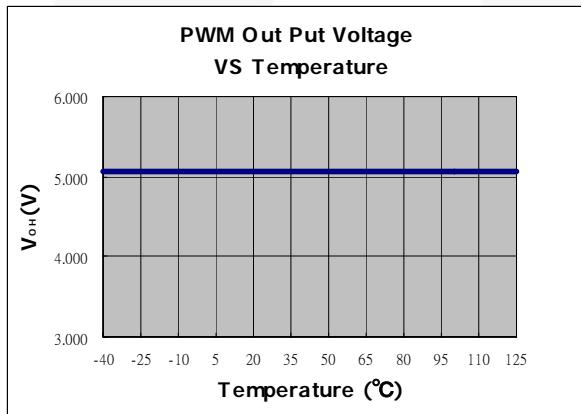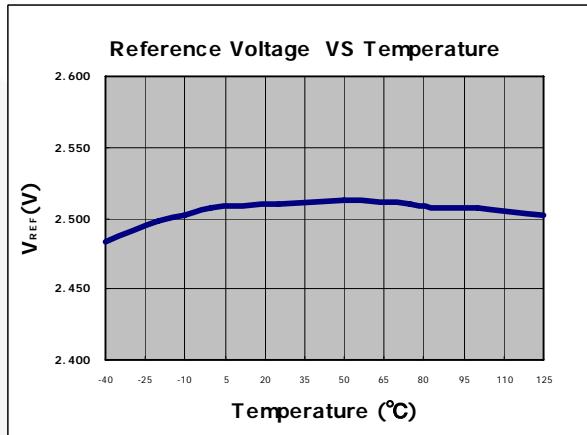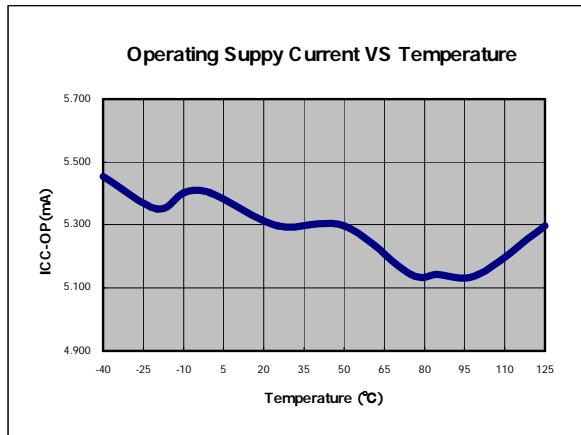
PWM Output Section

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{OL}	Output Voltage Low	$I_O = 20mA$			0.8	V
V_{OH}	Output Voltage High	V12=12V	4			V
R_O	Output Impedance of V_{OH}		1.5		3.3	kΩ
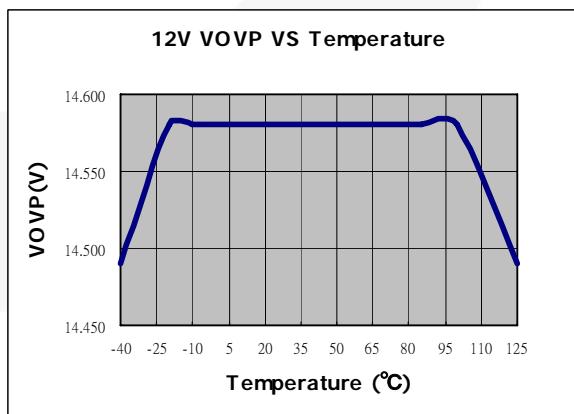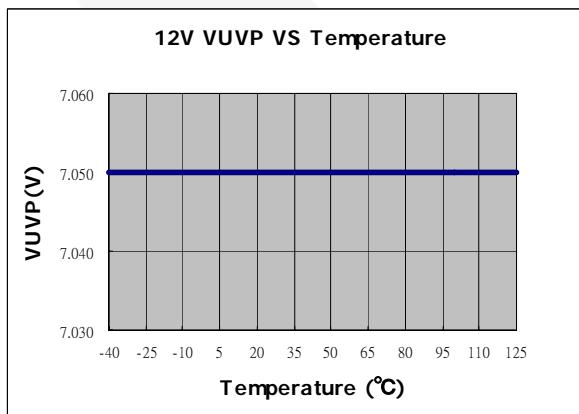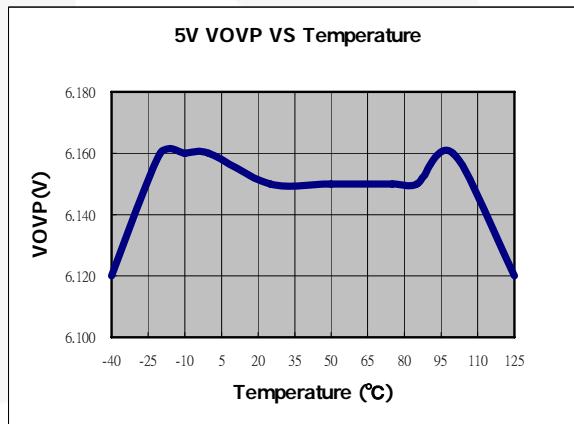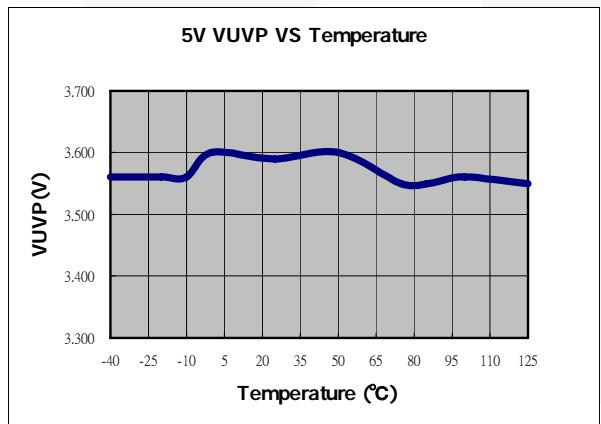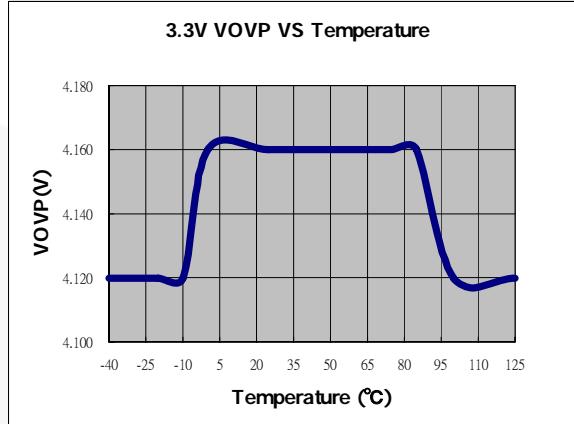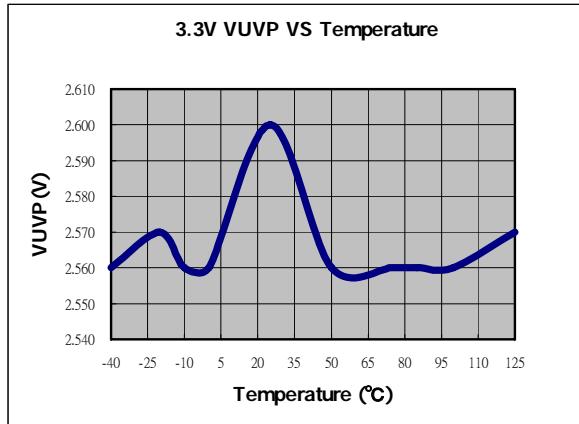
TYPICAL CHARACTERISTICS

Operating Supply Current VS Temperature

Reference Voltage VS Temperature

PWM Out Put Voltage VS Temperature

Frequency VS Temperature

MAX Duty Cycle VS Temperature

Reference Voltage VS Temperature

3.3V VUVP VS Temperature

3.3V VOVP VS Temperature

5V VUVP VS Temperature

5V VOVP VS Temperature

12V VUVP VS Temperature

12V VOVP VS Temperature

Example of Using SG6105A for the ATX

Power Supply

Protection against over-voltage, short-circuit, and fault conditions is mandatory in PC power supplies. These protection circuits can be realized by using many discrete components and comparators, which occupy a lot of PCB space and add to assembling costs. This single chip controller IC provides complete protection circuits, shunt regulators, and PWM control function with fewer components. SG6105A is an ideal controller IC for PC switching mode power supplies.

The features and benefits of this device are:
- Over-voltage and under-voltage protection for 3.3V, 5V, and 12V without external divider
- Over-power protection
- UV protection for –12V and/or –5V
- Power-down warning for power-good signal
- Power-good signal and power-fail lockup
- Remote on/off control
- Delay time for PSON and PS-off signal
- Two shunt regulators for 3.3V and 5V-standby regulation
- Complete pulse width modulation (PWM) control circuitry
- On-chip oscillator
- Programmable soft-start
- Maximum 93% duty cycle
- Few external components
- More reliable system
- Little space on PCB
- Easy trouble-shooting and implementation

FEATURE DESCRIPTIONS

- Over-voltage protection can be implemented without any additional components. Over-voltage sense levels for 3.3V, 5V, 12V, are 4.1V, 6.1V, 14.5V, respectively.
- Over-current and/or short-circuit protection can also be achieved using over-power protection, in which the OPP pin is connected to the current transformer (driver transformer).
- The power-good signal is asserted to indicate the 3.3V, 5V, and 12V is above the under-voltage threshold level. PG pin goes high when the above

condition is reached. A 2K pull-up resistor may connect to 5V.
- The V_{CC} can be supplied from the 5V-standby. When the V_{CC} voltage is higher than 7V, besides the shunt regulator, the circuit is shutdown and reset. No extra power supply is needed.
- Two internal high-precision 431 shunt regulators are built-in to provide stable reference voltages.
- Complete PWM control circuitry, including the error amplifier for push-pull or half-bridge operation.

Supervisory Circuit Operation

The PC generates the remote ON/OFF logic (PSON), which is "Low" for power supply on and "High" to switch off the power supply. The remote ON/OFF is connected to PSON input.

APPLICATION GUIDES

Introduction
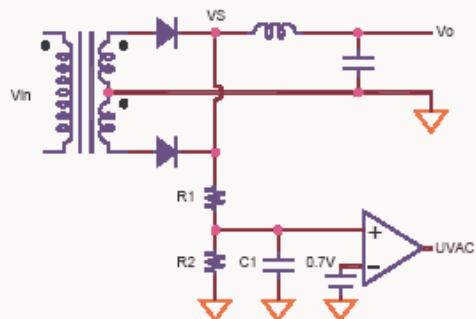
The application guide shows the key features of SG6105A and illustrates how to design in an ATX switching mode power supply (SMPS). SG6105A is suitable for half-bridge, push-pull topology and incorporates with a four-channel supervisor, including 5V-standby. The PWM section of SG6105A comprises a built-in 65kHz oscillator and high-immunity circuits, which protect the system from noise interference and provide more noise margins for improper PCB layout. SG6105A 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 (AC fails detection) is applied to detect AC line condition. Two built-in internal precision TL431 shunt regulators can be used for 3.3V or 5V auxiliary standby power.

AC Fails 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 (power-good) signal is pulled low to indicate an AC line power-down condition. The voltage amplitude of the PWM switching
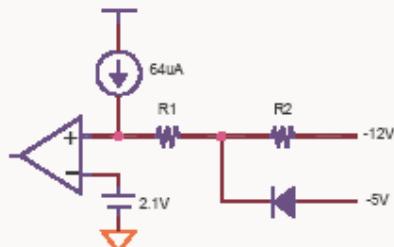
signal in the secondary power transformer is proportional to the AC line voltage. Adjust the ratio of resistor divider to decide the threshold of power-down warning. A small capacitor is connected from UVAC to ground for filtering the switching noise.


Over-Power Protection (OPP)

The OPP (over-power protection) is used for detecting over-power and/or short-circuit conditions. When OPPS voltage (p.4, Note-1) is higher than 2.1V and this situation exists for longer than 7ms, 6105A pulls the PG low and locks off the power outputs.

Negative Voltage Protection (NVP)

The NVP provides an under-voltage protection (UVP)for negative voltage outputs. An under-voltage represents the phenomenal 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 outputs a 64µA constant current to the negative voltage output. When the NVP voltage is over 2.1V and the situation kept for longer than 7ms, 6105A locks the power outputs off:

$$VNVP = 64µA × (R1 + R2) – V\text{-}12V \qquad (1)$$

The power outputs are locked off when VNVP ≥ 2.1V.

REFERENCE CIRCUIT

BOM

Reference	Component	Reference	Component
D1,D2,D6	PR1004	R14	100KΩ 1%
D3	20A45V	R15	47KΩ 1/8W
D4,D5	30C40	R16	9.47KΩ 1/8W
D7,D8,D9,D10,D11	1N4148	R17	1.5KΩ 1%
R1	62K 1/8W	R18	1.45K 1%
R2	3.2K 1/8W	R19	39Ω 1/8W
R3	510Ω 1%	R20	1KΩ 1/8W
R4	1.5KΩ 1%	R21	96.7KΩ 1/8W
R5	100Ω 1/8W	R22	10KΩ 1/8W
R6	100Ω 1/8W	C1	101/50V
R7	1KΩ 1/8W	C2,C5	2.2uF/50V
R8	47~100Ω	C3,C6	103/50V
R9	1KΩ	C4	333/50V
R10	95.3KΩ	Q1	A928
R11	93.7KΩ	Q2,Q3	2SC945
R12	75KΩ	U1	P817C
R13	14.2KΩ 1%	U2	SG6105A

PACKAGE INFORMATION

20 PINS – DIP (D)

Dimensions:

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	24.892	26.162	26.924	0.980	1.030	1.060
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
e$_B$	8.509	9.017	9.525	0.335	0.355	0.375
θ°	0°	7°	15°	0°	7°	15°

TRADEMARKS

The following are registered and unregistered trademarks and service marks Fairchild Semiconductor owns or is authorized to use and is not intended to be an exhaustive list of all such trademarks.

ACEx®	Green FPS™	Power247®	SuperSOT™-8
Build it Now™	Green FPS™ e-Series™	POWEREDGE®	SyncFET™
CorePLUS™	GTO™	Power-SPM™	The Power Franchise®
CROSSVOLT™	i-Lo™	PowerTrench®	
CTL™	IntelliMAX™	Programmable Active Droop™	
Current Transfer Logic™	ISOPLANAR™	QFET®	TinyBoost™
EcoSPARK®	MegaBuck™	QS™	TinyBuck™
ℱ®	MICROCOUPLER™	QT Optoelectronics™	TinyLogic®
Fairchild®	MicroFET™	Quiet Series™	TINYOPTO™
Fairchild Semiconductor®	MicroPak™	RapidConfigure™	TinyPower™
FACT Quiet Series™	MillerDrive™	SMART START™	TinyPWM™
FACT®	Motion-SPM™	SPM®	TinyWire™
FAST®	OPTOLOGIC®	STEALTH™	µSerDes™
FastvCore™	OPTOPLANAR®	SuperFET™	UHC®
FPS™	⏻®	SuperSOT™-3	UniFET™
FRFET®	PDP-SPM™	SuperSOT™-6	VCX™
Global Power Resource℠	Power220®		

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.

PRODUCT STATUS DEFINITIONS

Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
Preliminary	First Production	This 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	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice to improve design.
Obsolete	Not In Production	This datasheet contains specifications on a product that has been discontinued by Fairchild Semiconductor. The datasheet is printed for reference information only.

Rev. I31