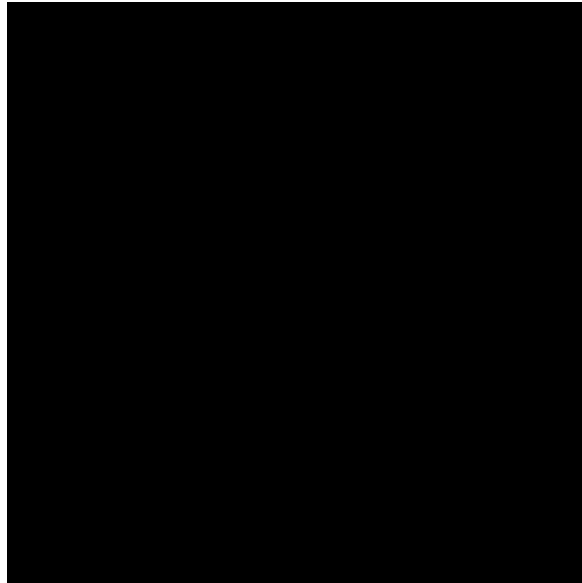




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FSD146MRBN

Green-Mode Fairchild Power Switch (FPS™)

Features

- Advanced Soft Burst-Mode Operation for Low Standby Power and Low Audible Noise
- Random Frequency Fluctuation for Low EMI
- Pulse-by-Pulse Current Limit
- Various Protection Functions: Overload Protection (OLP), Over-Voltage Protection (OVP), Abnormal Over-Current Protection (AOCP), Internal Thermal Shutdown (TSD) with Hysteresis, Output-Short Protection (OSP), and Under-Voltage Lockout (UVLO) with Hysteresis
- Low Operating Current (0.4mA) in Burst Mode
- Internal Startup Circuit
- Internal High-Voltage SenseFET: 650V
- Built-in Soft-Start: 15ms
- Auto-Restart Mode

Description

The FSD146MRBN is an integrated Pulse Width Modulation (PWM) controller and SenseFET designed for offline Switch-Mode Power Supplies (SMPS) with minimal external components. The PWM controller includes an integrated fixed-frequency oscillator, Under-Voltage Lockout (UVLO), Leading-Edge Blanking (LEB), optimized gate driver, internal soft-start, temperature-compensated precise current sources for loop compensation, and self-protection circuitry. Compared with a discrete MOSFET and PWM controller solution, the FSD146MRBN can reduce total cost, component count, size, and weight; while simultaneously increasing efficiency, productivity, and system reliability. This device provides a basic platform that is well suited for cost-effective design of a flyback converter.

Applications

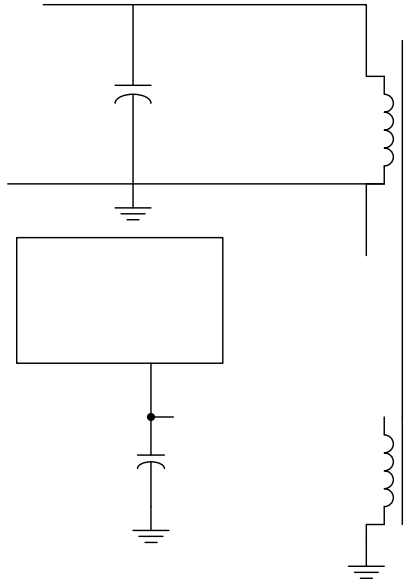
- Power Supply for LCD Monitor, STB, and DVD Combination

Ordering Information

Output Power Table⁽²⁾

Part Number	Package	Operating Junction Temperature	Current Limit	$R_{DS(ON)}$ (Max.)
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Application Circuit



Pin Configuration

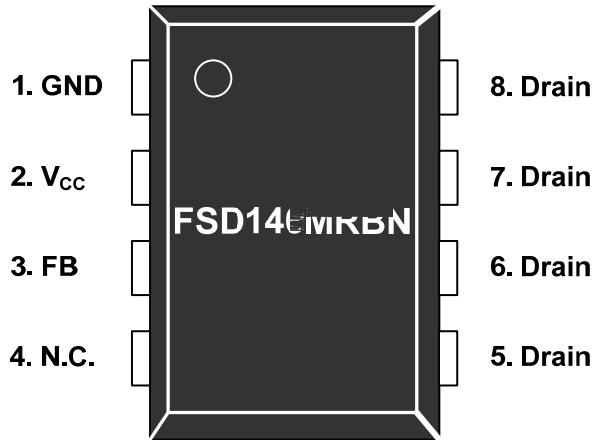


Figure 3. Pin Configuration (Top View)

Pin Definitions

Pin #	Name	Description
1	GND	Ground. This pin is the control ground and the SenseFET source.
2	V _{CC}	Power Supply. This pin is the positive supply input, which provides the internal operating current for both startup and steady-state operation.
3	FB	Feedback. This pin is internally connected to the inverting input of the PWM comparator. The collector of an opto-coupler is typically tied to this pin. For stable operation, a capacitor

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.

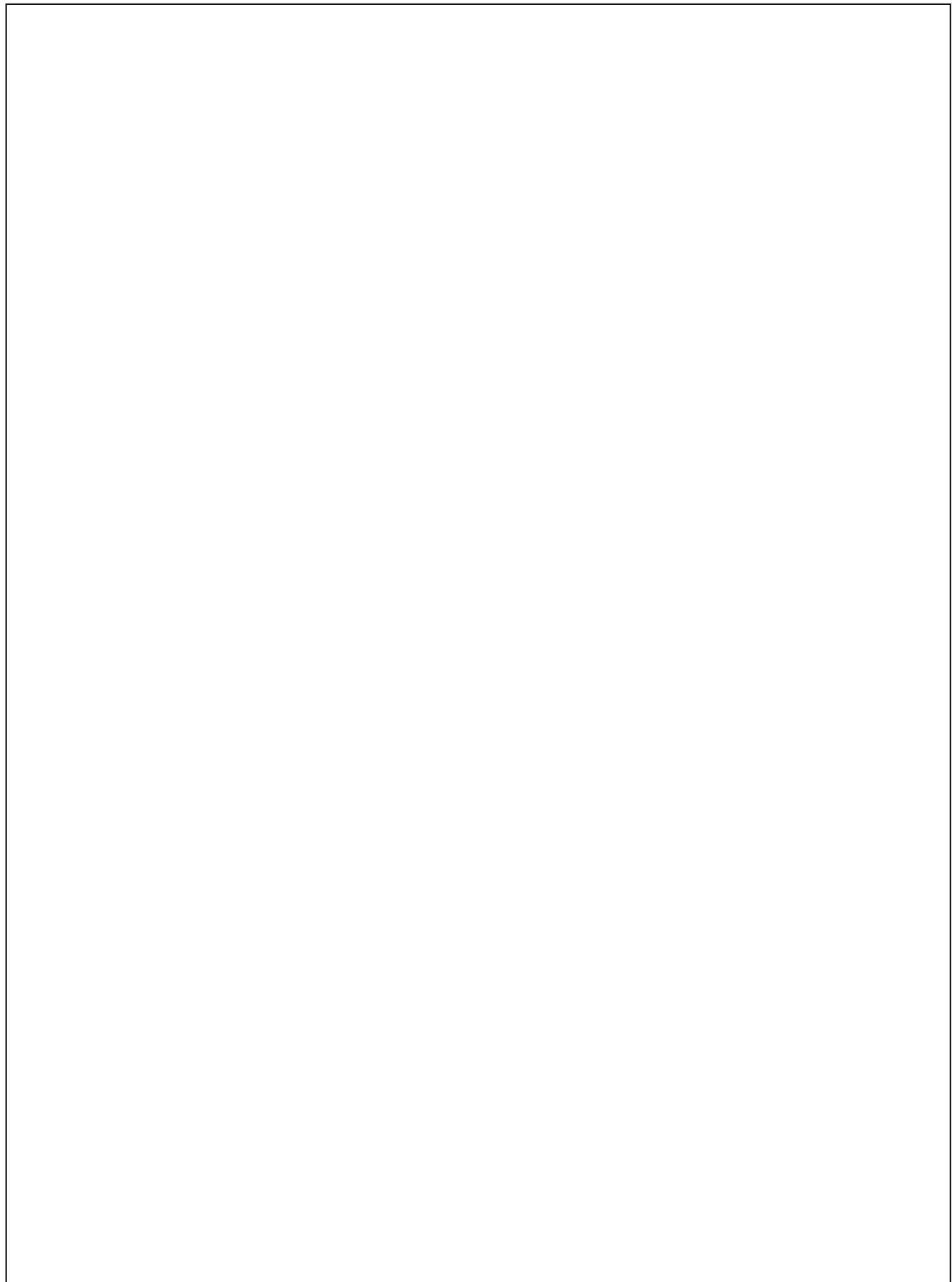
Symbol	Parameter	Min.	Max.	Unit
V_{DS}	Drain Pin Voltage		650	V
V_{CC}	V_{CC} Pin Voltage		26	V
V_{FB}	Feedback Pin Voltage	- 0.3	10.0	V
I_{DM}	Drain Current Pulsed		3.4	A

I_{DS} Continuous Switching Drain Current

Electrical Characteristics

$T_J = 25\text{ C}$ unless otherwise specified.

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
SenseFET Section						
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{CC} = 0V, I_D = 250\text{ A}$	650			V
I_{DSS}	Zero-Gate-Voltage Drain Current	$V_{DS} = 650V, T_A = 25\text{ C}$			250	A
$R_{DS(ON)}$	Drain-Source On-State Resistance	$V_{GS} = 10V, I_D = 1A$		2.1	2.6	
C_{ISS}	Input Capacitance ⁽¹²⁾	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$		436		pF
C_{OSS}	Output Capacitance ⁽¹²⁾	$V_{DS} = 25V, V_{GS} = 0V, f = 1MHz$		65		pF
t_r	Rise Time	$V_{DS} = 325V, I_D = 4A, R_G = 25$		24		ns
t_f	Fall Time	$V_{DS} = 325V, I_D = 4A, R_G = 25$		24		ns
$t_{d(on)}$	Turn-On Delay	$V_{DS} = 325V, I_D = 4A, R_G = 25$		13		ns
$t_{d(off)}$	Turn-Off Delay	$V_{DS} = 325V, I_D = 4A, R_G = 25$		30		ns
Control Section						
f_s	Switching Frequency ⁽¹²⁾	$V_{CC} = 14V, V_{FB} = 4V$	61	67	73	kHz

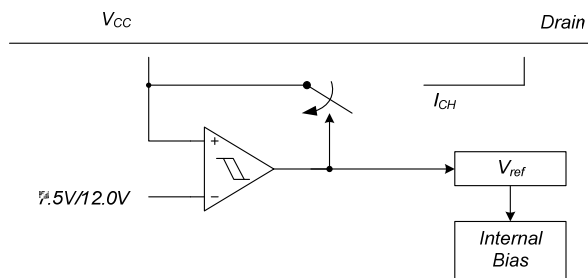




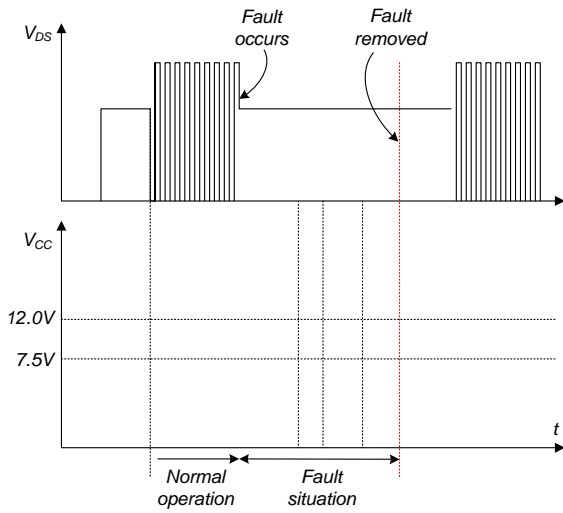
Typical Performance Characteristics

Functional Description

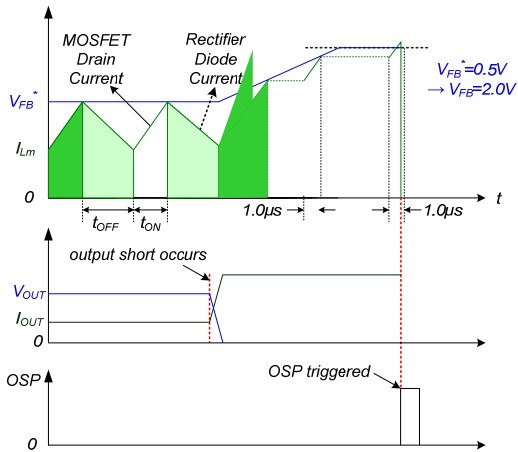
1. Startup: At startup, an internal high-voltage current source supplies the internal bias and charges the external capacitor (C_{VCC}) connected to the V_{CC} pin, as illustrated in Figure 17. When V_{CC} reaches 12V, the FSD146MRBN begins switching and the internal high-voltage current source is disabled. The FSD146MRBN continues normal switching operation and the power is supplied from the auxiliary transformer winding unless V_{CC} goes below the stop voltage of 7.5V.



4. Protection Circuits: The FSD146MRBN has several self-protective functions, such as Overload Protection (OLP), Abnormal Over-Current Protection (AOCP), Output-Short Protection (OSP), Over-Voltage Protection (OVP), and Thermal Shutdown (TSD). All the protections are implemented as auto-restart. Once the fault condition is detected, switching is terminated and the SenseFET remains off. This causes V_{CC} to fall. When V_{CC} falls to the Under-Voltage Lockout (UVLO) stop voltage of 7.5V, the protection is reset and the startup circuit charges the V_{CC} capacitor. When V_{CC} reaches the start voltage of 12.0V, the FSD146MRBN resumes normal operation. If the fault condition is not removed, the SenseFET remains off and V_{CC} drops to stop voltage again. In this manner, the auto-restart can alternately enable and disable the switching of the power SenseFET until the fault condition is eliminated. Because these protection circuits are fully integrated into the IC without external components, the reliability is improved without increasing cost.



4.3. Output-Short Protection (OSP): If the output is shorted, steep current with extremely high di/dt can flow through the SenseFET during the minimum turn-on time. Such a steep current brings high-voltage stress on the drain of the SenseFET when turned off. OSP protects the device from this abnormal condition. It is comprised of detecting V_{FB} and SenseFET turn-on time. When the V_{FB} is higher than 2.0V and the SenseFET turn-on time is lower than 1.0 μ s, this condition is recognized as an abnormal error and PWM switching shuts down until V_{CC} reaches V_{START} again. An abnormal condition output short is shown in Figure 22.



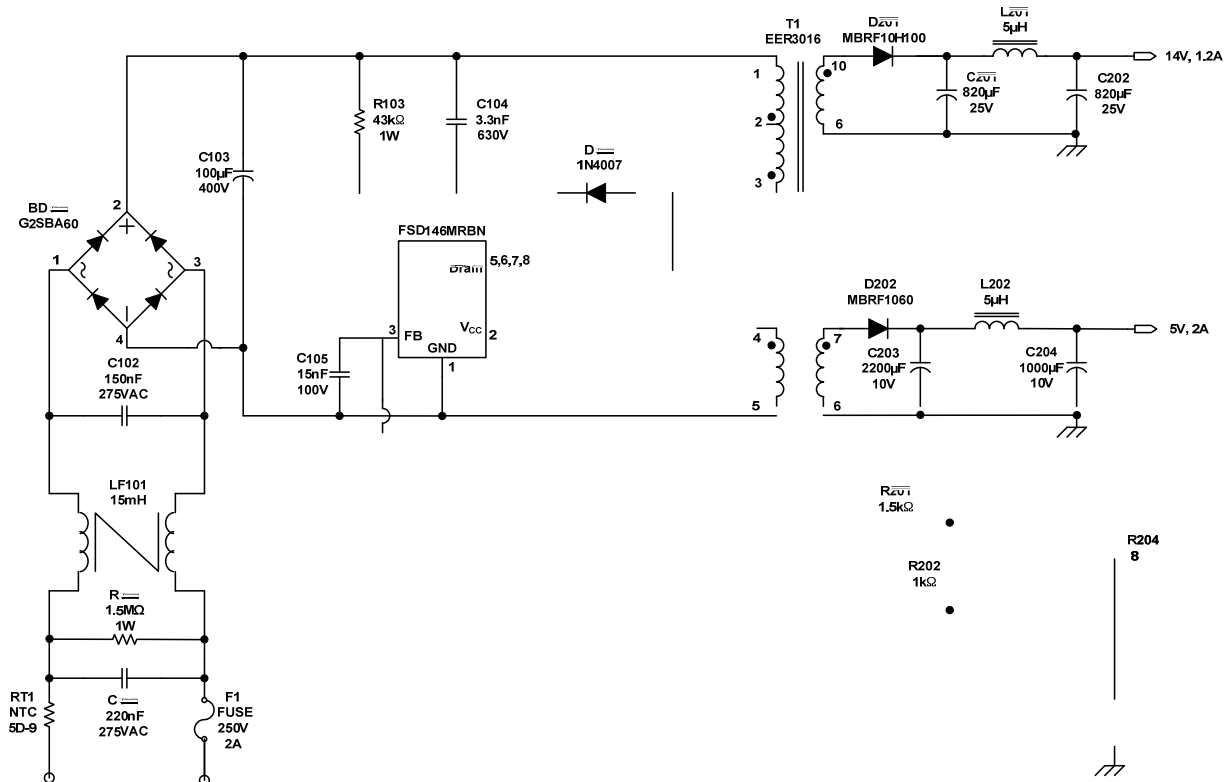
Typical Application Circuit

Application	Input Voltage	Rated Output	Rated Power
LCD Monitor Power Supply	85 ~ 265V _{AC}	5.0V(2A) 14.0V(1.2A)	26.8W

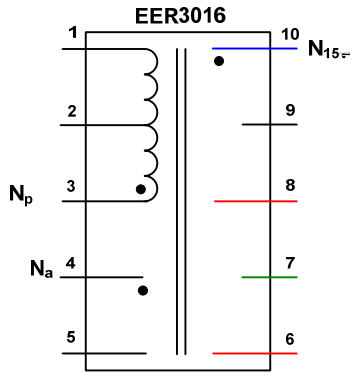
Key Design Notes:

1. The delay for overload protection is designed to be about 30ms with C105 (8.2nF). OLP time between 39ms (12nF) and 46ms (15nF) is recommended.
2. The SMD-type capacitor (C106) must be placed as close as possible to the V_{CC} pin to avoid malfunction by abrupt pulsating noises and to improve ESD and surge immunity. Capacitance between 100nF and 220nF is recommended.

Schematic



Transformer



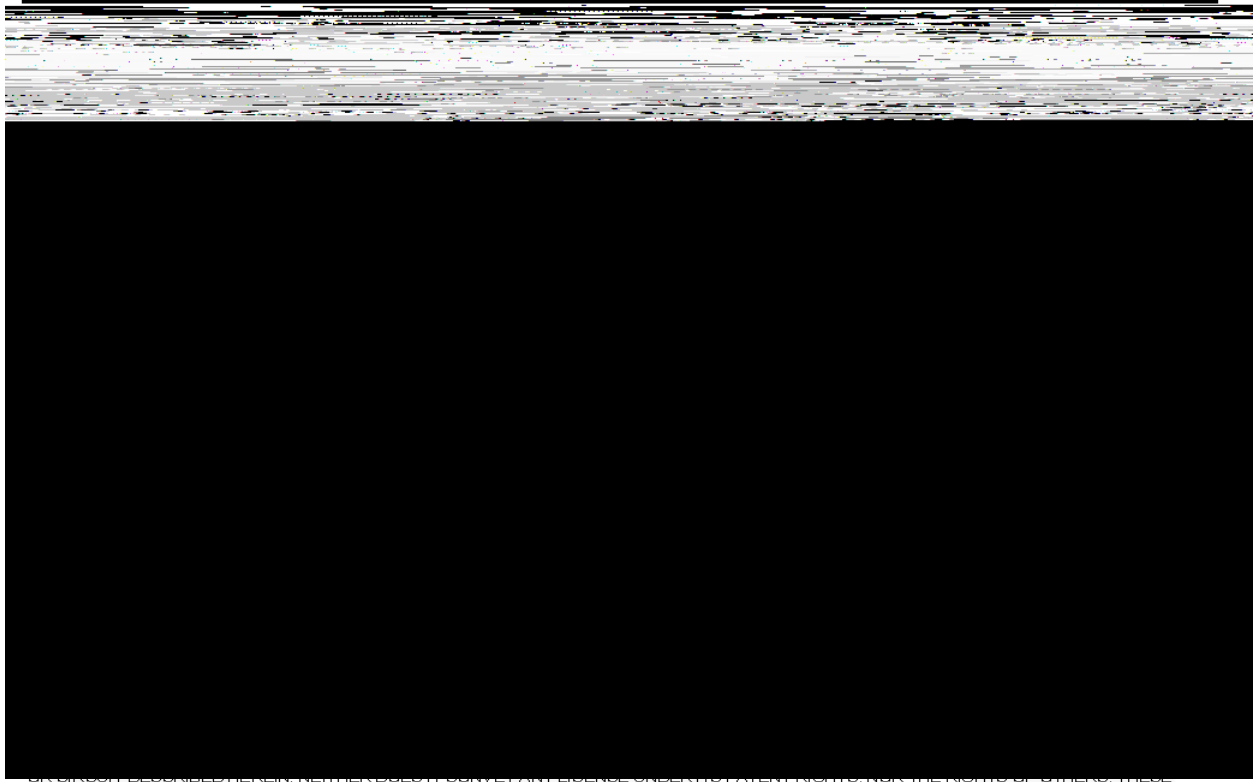
Bill of Materials

Part #	Value	Note	Part #	Value	Note
Fuse			Capacitor		
F101	250V 2A		C101	220nF/275V	Box (Pilkor)
NTC			C102	150nF/275V	Box (Pilkor)
NTC101	5D-9	DSC	C103	100 F/400V	Electrolytic (SamYoung)
Resistor			C104	3.3nF/630V	Film (Sehwa)
R101	1.5M , J	1W	C105	15nF/100V	Film (Sehwa)
R103	43k , J	1W	C106	100nF	SMD (2012)
R201	1.5k , F	1/4W, 1%	C107	47 F/50V	Electrolytic (SamYoung)
R202	1.0k , F	1/4W, 1%	C201	820 F/25V	Electrolytic (SamYoung)
R203	18k , F	1/4W, 1%	C202	820 F/25V	Electrolytic (SamYoung)
R204	8k , F	1/4W, 1%	C203	2200 F/10V	Electrolytic (SamYoung)
R205	8k , F	1/4W, 1%	C204	1000 F/16V	Electrolytic (SamYoung)
			C205	47nF/100V	Film (Sehwa)
			C301	2.2nF/Y2	Y-cap (Samhwa)
IC			Inductor		
FPS	FSD146MRBN	Fairchild	LF101	20mH	Line filter 0.5Ø
IC201	KA431LZ	Fairchild	L201	5 H	5A Rating
IC301	FOD817B	Fairchild	L202	5 H	5A Rating
Diode			Transformer		
D101	1N4007	Vishay	T101	826 H	
D102	UF4007	Vishay			
ZD101	1N4750	Vishay			
D201	MBRF10H100	Fairchild			
D202	MBRF1060	Fairchild			
BD101	G2SBA60	Vishay			

Physical Dimensions

Figure 27. 8-Lead, MDIP, JEDEC MS-001, .300" Wide

Package drawings are provided as a service to customers considering Fairchild components. Drawings may change in any manner without notice. Please note the revision and/or date on the drawing and contact a Fairchild Semiconductor representative to



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