GENERAL DESCRIPTION

SN97Bx is a high performance and highly integrated secondary side synchronous rectifier used for secondary side rectification in switch mode power supply system. It integrates a 100V power MOSFET to emulate the traditional diode rectifier at the secondary side of flyback converter, which can reduce heat dissipation, increase output current capability and efficiency, and simplify thermal design.

It is suitable for multiple mode applications including discontinuous conduction mode (DCM), quasi-resonant mode (QR) and continuous conduction mode (CCM). The Drain-to-GND voltage of SN97Bx is sensed to control the integrated MOSFET on and off. In addition, to reduce SR falling time further, soft gate is implemented in SN97Bx, which would pull down the gate voltage level before being turned off thoroughly.

SN97Bx is offered in PDFN8(5*6) package.

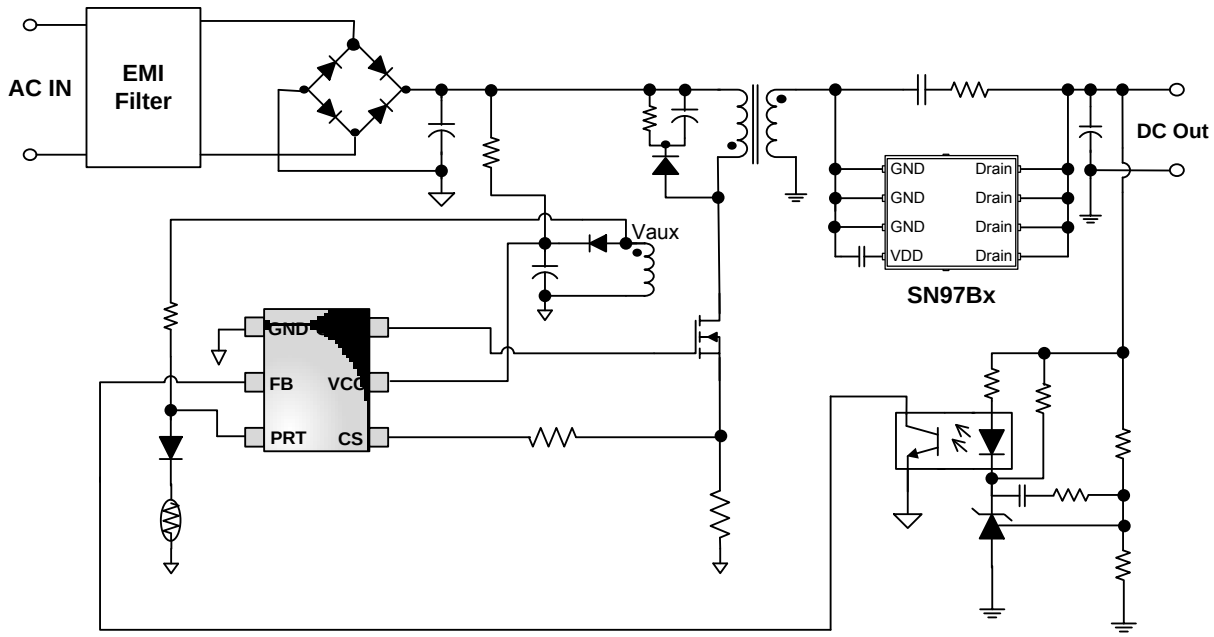
FEATURES

- Integrated 100V N-channel MOSFET
- Self-supplying for operation without the use of an auxiliary winding
- Suitable for DCM, QR and CCM operation
- Soft gate drive for fast turn-off
- Accurate Drain voltage sensing
- Innovative property ring detection to avoid the ring impact induced by parasitic elements
- VDD UVLO protection

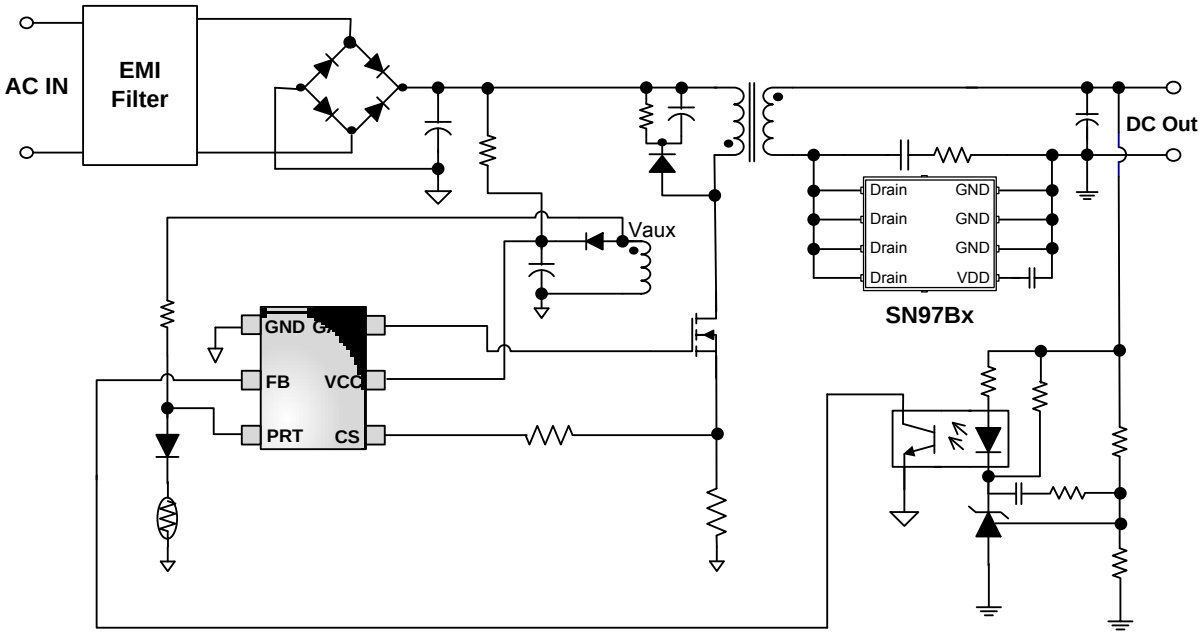
APPLICATIONS

- QC and PD Charger
- AC/DC adaptors
- Low voltage rectification circuits

TYPICAL APPLICATION



high side synchronous rectification

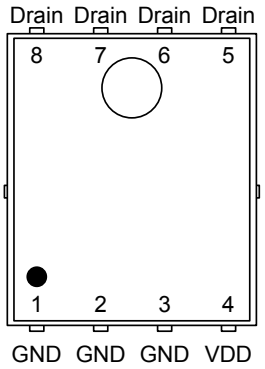


low side synchronous rectification

GENERAL INFORMATION

Pin Configuration

The SN97Bx is offered in PDFN8(5*6) package, shown as below.



Ordering Information

Part Number	Description
SN97BFWLP-D	PDFN8(5*6), Halogen-free in tube
SN97BFWLPA-D	PDFN8(5*6), Halogen-free in T&R

Package Dissipation Rating

Package	RθJA(℃/W)	RθJC(℃/W)
PDFN8(5*6)	50	6

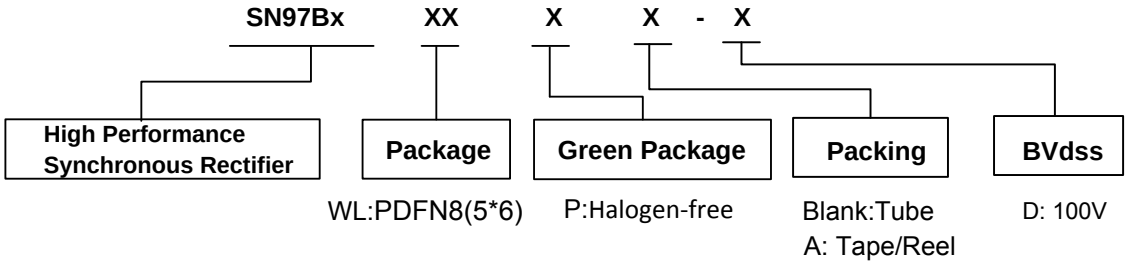
Absolute Maximum Ratings

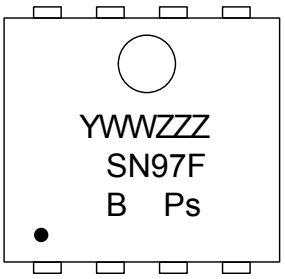
Parameter	Value
VDD pin	-0.6V to 7V
Drain pin	-2.5V to BVdss Note2
Min/Max Operating Junction Temperature TJ	-40 to 150 ℃
Min/Max Storage Temperature Tstg	-55 to 150 ℃
Lead Temperature (Soldering, 10secs)	260 ℃

Note1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

Note2: -2.5V applies to minimum duty cycle during normal operation only.

Marking Information



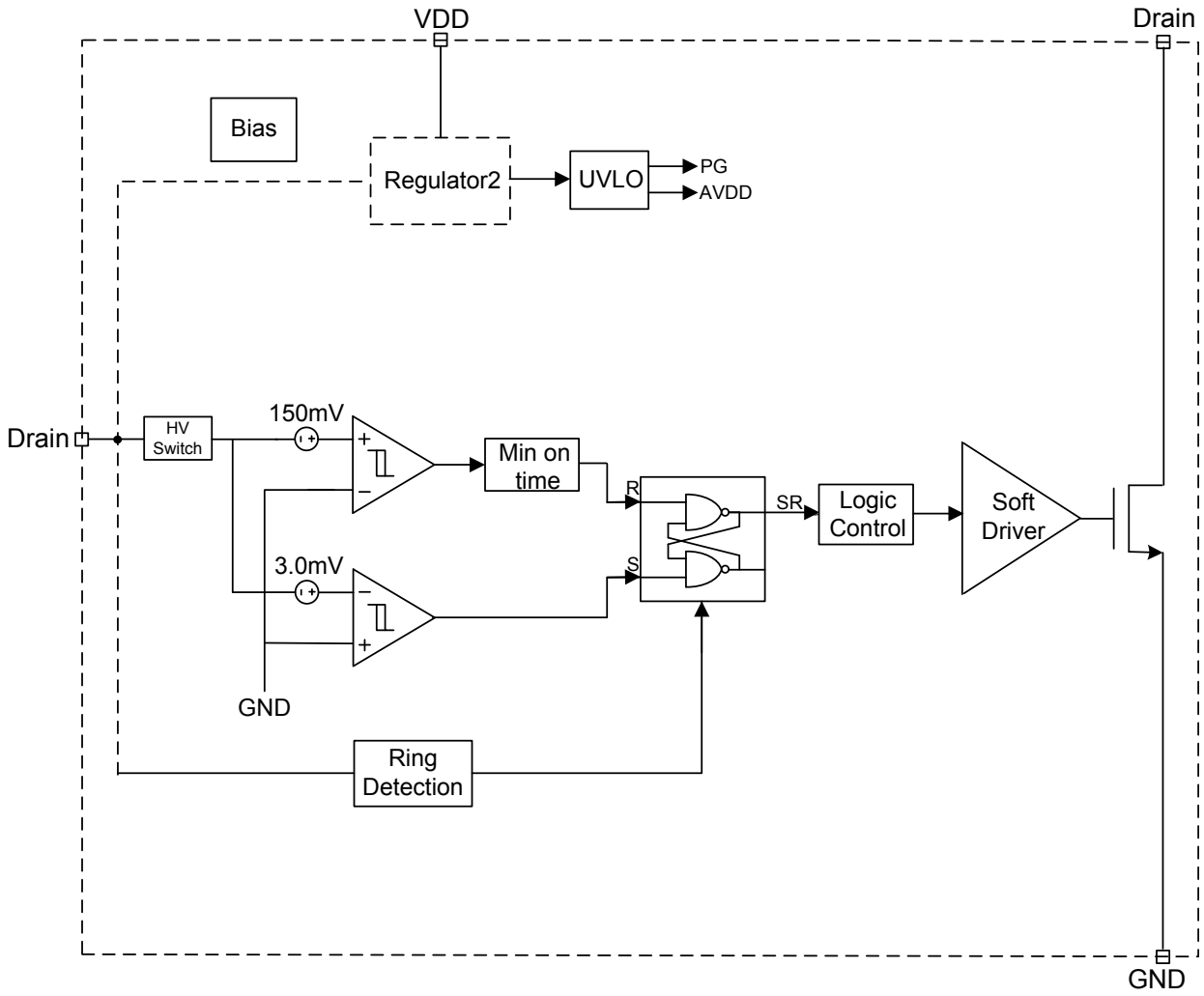


Y:Year Code
WW:Week Code(01-52)
ZZZ:Lot Code
F:MOS Code
B:Character Code
P:Halogen-free
S:Internal Code(Optional)

TERMINAL ASSIGNMENTS

Pin Name	I/O	Description
GND	P	Ground
VDD	P	Power Supply
Drain	I	SR MOSFET Drain pin

BLOCK DIAGRAM



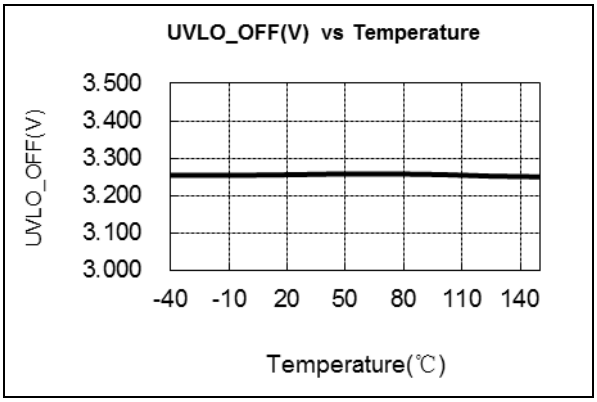
ELECTRICAL CHARACTERISTICS

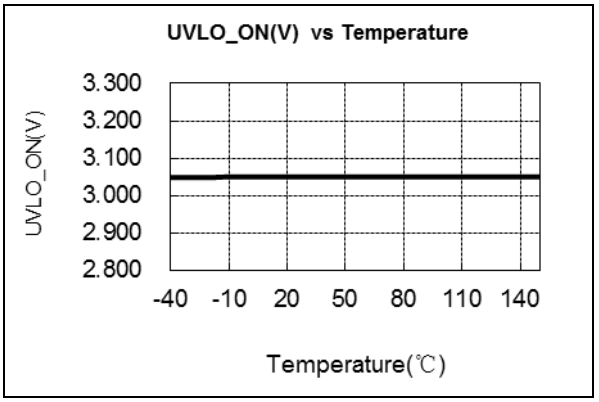
(T_A = 25℃, VDD=6.5V, unless otherwise noted)

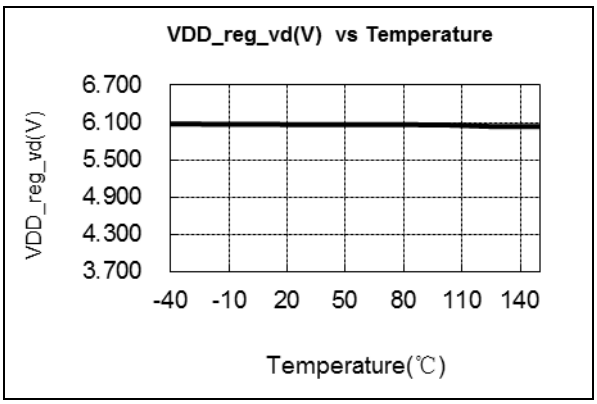
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD)						
I_VDD_operation	Operation current	Frequency@Drain=50kHz, Duty=25%, High level @ Drain=20V, Low level @ Drain=-0.5V, VDD=6.15V		1.8	2.0	mA
		Drain=5V, VDD=5V		0.25		mA
VDD_regulation	VDD regulation voltage	Frequency@Drain =50kHz, Duty=25%,High level @ Drain =20V,Low level @ Drain =-0.5V, 1uF Cap connected from VDD to ground	5.85	6.15	6.45	V
UVLO(OFF)	VDD Under Voltage Lockout Exit		3.0	3.2	3.4	V
UVLO(ON)	VDD Under Voltage Lockout Enter		2.8	3.0	3.2	V
Drain Detection Section						
Vth_SR_act	SR MOSFET turn on threshold voltage detection at Drain		-200	-150	-100	mV
Vth_SR_deact	SR MOSFET turn off threshold voltage detection at Drain			-3		mV
Tdelay_on	SR MOSFET fast path turn-on propagation delay			20	50	ns
	SR MOSFET slow path turn-on propagation delay			220	300	ns
Tdelay_off	SR MOSFET turn-off propagation delay			10	25	ns
T_minimum_on	SR minimum on time		0.8	1.0	1.2	us
Vds_reg	Vds regulation voltage			-40		mV
Vth_fast_off	SR MOSFET fast turn off threshold voltage detection at Drain, during min on time			0.5		V
Tring_det	Ring detection time window			150		ns

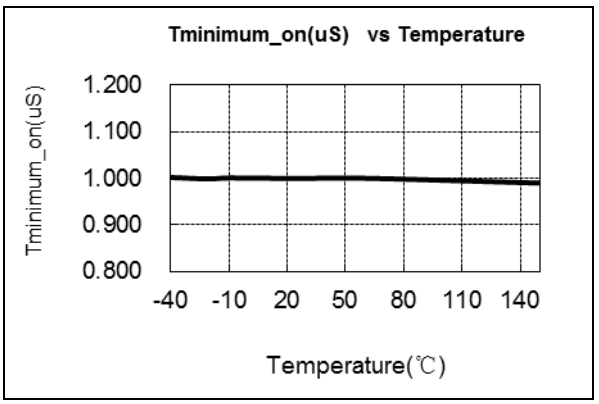
Parameter / Product	BVdss(V) MOSFET Drain-Source Breakdown Voltage			Rds,on(mΩ) Note1 On resistance		
	Min	Typ.	Max	Min	Typ.	Max
SN97BFWLP-D	100				6.5	

CHARACTERIZATION PLOTS









Operation Description

SN97Bx is a high performance and highly integrated secondary side synchronous rectification controller in switch mode power supply system. It integrates a 100V power MOSFET to emulate the traditional diode rectifier, which can reduce heat dissipation, increase output current capability and efficiency, and simplify the thermal design..

Startup and under voltage lockout (UVLO)

Whether SN97Bx can operate normally or not depends on UVLO function implemented on chip. When power system is plugged in, VDD cap is charged from transformer secondary winding. When VDD rises above UVLO(off), the IC wakes up from under voltage lock out state, refer to Fig.1.

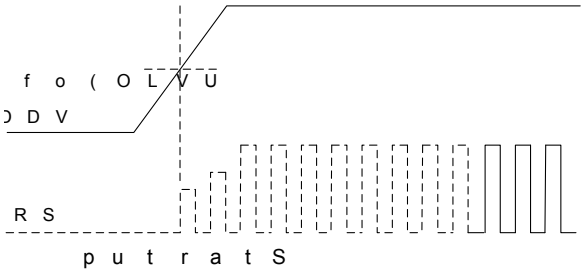


Fig.1 System start up timing diagram

When VDD drops below UVLO(on),SR would be disable, refer to the following timing diagram. The hysteresis window between UVLO(off) and UVLO(on) makes system work reliably.

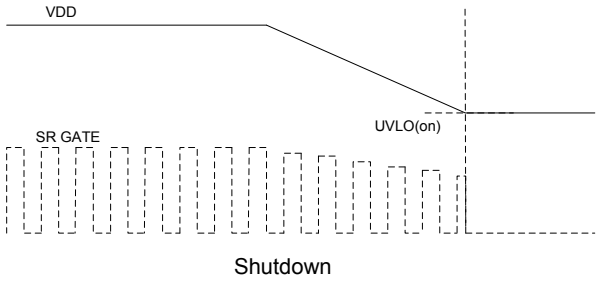


Fig.2 System shut down timing diagram

Besides, the gate driver is kept low to avoid the misconducting by Drain pulse coupling before VDD rises to UVLO(off).

Turn-on and Turn-off Phase

SN97Bx controls the turn-on and turn-off of integrated MOSFET by detection of Drain-GND voltage. When demagnetization of transformer starts, the secondary-side current will flow through the body diode of SR MOSFET and the voltage at the Drain will drop to below -700mV (typical). As soon as SN97Bx detects this negative voltage and the Drain falling time is lower than 150ns, the driver voltage is pulled high to turn on the SR MOSFET after variable delay time(Tdelay_on) depending on input line voltage and loading condition, refer to Fig.3. This variable delay time can improve system immunity to noise.

After the SR MOSFET is turned on, the Drain voltage of SR MOSFET begins to rise based on its Rds(on) and secondary-side current. The Drain voltage becomes higher with demagnetization goes on. When the Drain voltage rises above SR turn off threshold, the gate of SR MOSFET will be pulled down to ground very quickly after turn-off delay, refer to Fig.3.

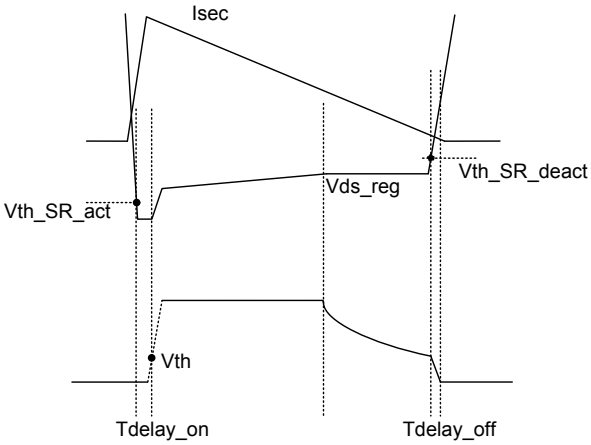


Fig.3 Synchronous Rectification Operation

Conduction Phase

Once the SR MOSFET is turned on, the gate drive voltage will remain at the high level during minimum on time. With the decrease of the switching current, the VDS will rise above Vth_reg(typ. -40mV), then the soft gate control is implemented. The gate voltage is pulled lower to enlarge the Rds(on) of the synchronous MOSFET, therefore VDS is adjusted to remain at -40mV during the rest of demagnetization time. The low level gate voltage saves the pull-down time, resulting in higher turn-off speed, which is very important in CCM mode.

Minimum on time

To avoid effectively false turn-off due to high frequency interference caused by parasitic element at the start of secondary-side demagnetization, SN97Bx offers a blanking time(minimum turn-on time) of 1 μ s. During minimum turn-on time, the turn-off threshold is not

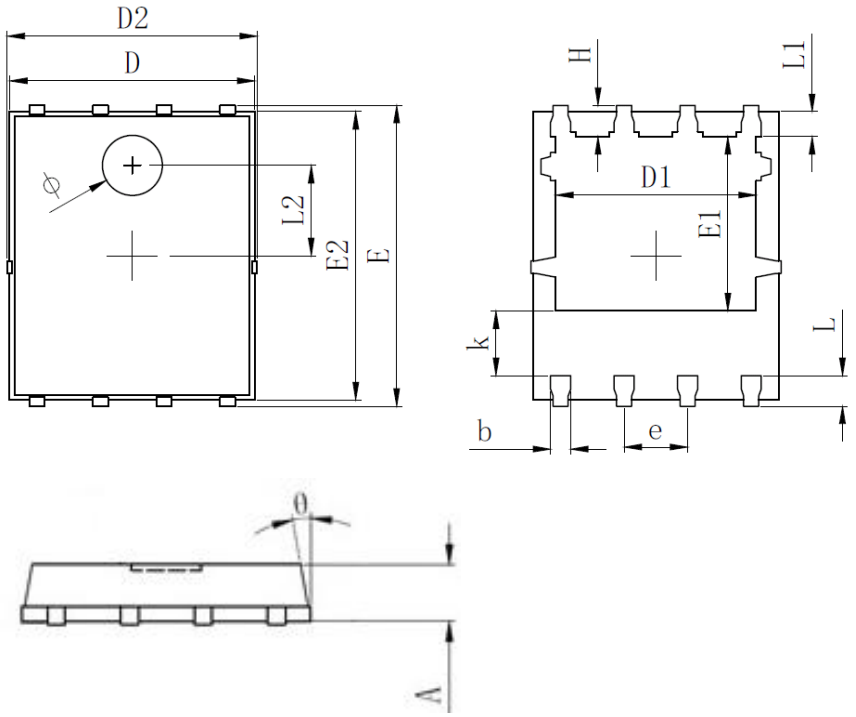
blanked completely and changed to 500mV to avoid shoot-through.

Adaptive minimum off time

At the end of demagnetization, SR MOSFET will be turned off. The remaining current may flow through body diode again, which may result in negative voltage (about -700mV) appears at Drain and SR MOSFET will be turned on again. At DCM mode, the resonant oscillations caused by magnetization inductance and parasitic capacitance after demagnetization may also cause negative Drain voltage. These may turn on SR MOSFET unexpectedly. An adaptive minimum off time control is implemented in SN97Bx, which can guarantee reliable synchronous rectification operation.

PACKAGE MECHANICAL DATA

PDFN8(5*6)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.200	0.035	0.047
D	4.800	5.200	0.189	0.205
D1	3.760	4.210	0.148	0.166
D2	-	5.300	-	0.209
E	5.900	6.300	0.232	0.248
E1	3.340	3.850	0.131	0.152
E2	5.650	6.000	0.222	0.236
b	0.300	0.500	0.012	0.020
e	1.270 (BSC)		0.050 (BSC)	
L	0.510	0.710	0.020	0.028
L1	0.424	0.676	0.017	0.027
L2	1.800 (REF)		0.071 (REF)	
H	0.510	0.810	0.020	0.032
θ	8°	14°	8°	14°
Φ	1.100	1.300	0.043	0.051

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