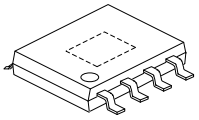
USRC8802

Advance ***CMOS IC***

FAST TURN-OFF INTELLIGENT RECTIFIER



HSOP-8

■ DESCRIPTION

The **UTC USRC8802** is a fast turn-off intelligent rectifier for Flyback converters that combines a 60V power switch that replaces diode rectifiers for high efficiency. The chip regulates the forward voltage drop of the internal power switch to about 70mV and turns it off before the voltage goes negative.

■ FEATURES

* Supports DCM and Quasi-Resonant
* Flyback converters
* Integrated 10mΩ 60V Power Switch
* Compatible with Energy Star, 1W Standby Requirements
* V_{DD} Range From 8V to 24V
* 70mV VDS Regulation Function
* Max 300kHz Switching Frequency
* Light Load Mode Function [(1)]with <300uA Quiescent Current
* Supports High-Side and Low-Side Rectification
* Power Savings of Up to 1.5W in a Typical Notebook Adapte

■ APPLICATION

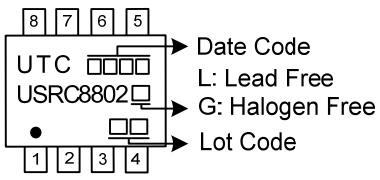
* Industrial Power Systems
* Distributed Power Systems
* Battery Powered Systems
* Flyback Converters

■ ORDERING INFORMATION

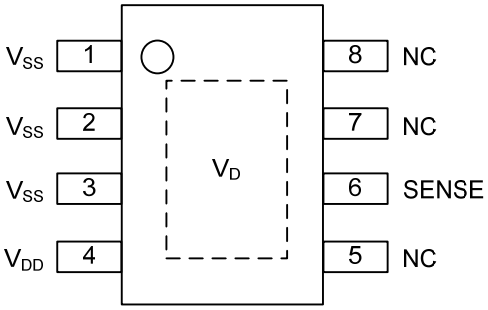
Ordering Number		Package	Packing
Lead Free	Halogen Free		
USRC8802L-SH2-R	USRC8802G-SH2-R	HSOP-8	Tape Reel

USRC8802G-SH2-R (1)Packing Type (2)Package Type (3)Green Package	(1) R: Tape Reel (2) SH2: HSOP-8 (3) G: Halogen Free and Lead Free, L: Lead Free

■ MARKING



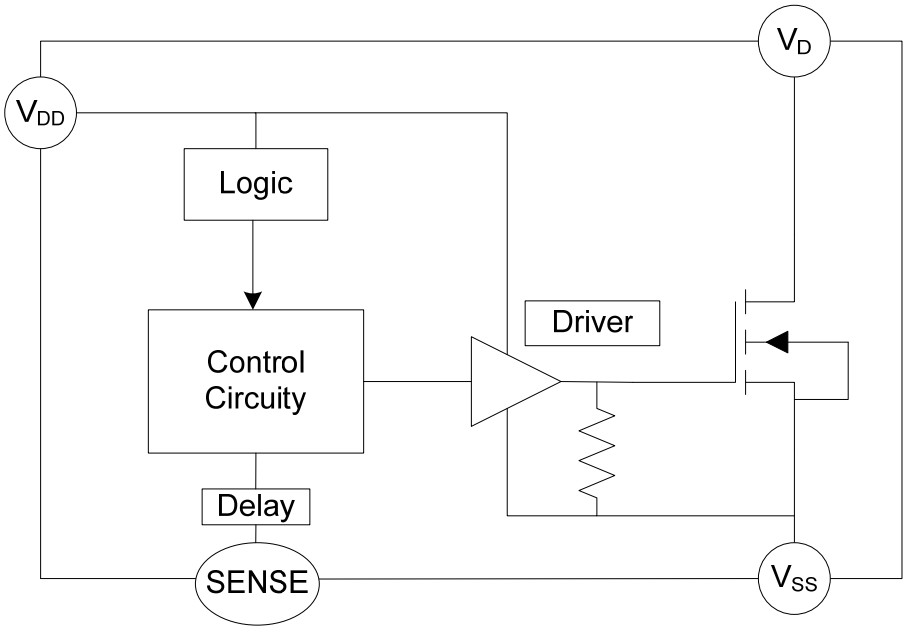
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN	Name	Description
1，2，3	V_{SS}	MOSFET Source, also used as reference for VDD
4	V_{DD}	Supply Voltage
5，7，8	NC	No connection
6	SENSE	Drain sense, connect this pin with exposed pad on the layout
EXPOSED PAD	V_D	MOSFET Drain

■ LOGIC DIAGRAM



■ ABSOLUTE MAXIMUM RATING (T_A=25°C, unless otherwise specified) (Note 2)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	VDD	-0.3 ~ 26	V
Sense Voltage	V_D	-0.7 ~ 60	V
Operating Frequency		300	kHZ
Junction Temperature		150	°C
Lead Temperature (Solder)		260	°C
Storage Temperature Range	T_{STG}	-55 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ RECOMMENDED OPERATING RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{DD}	8 ~ 24	V
Operating Junction Temperature	T_A	-40 ~ +125	°C

Notes: The device is not guaranteed to function outside of its operating conditions.

■ THERMAL DATA

PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient	θ_{JA}	50	°C/W

■ ELECTRICAL CHARACTERISTICS (V_{DD}=12V, T_A=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$		60			V
V_{DD} Voltage Range			8		24	V
V_{DD} UVLO Rising			5	6	7	V
V_{DD} UVLO Hysteresis			0.8	1.2	1.5	V
Operating Current	I_{CC}	fSW=100kHz		4.5	8	mA
Light-Load Current				260	360	μA
CONTROL CIRCUITRY						
V_{SS} –V_D Forward Voltage	V_{fwd}		55	70	85	mV
Turn-On Delay (Note 1)	t_{Don}			200		ns
Turn Off Threshold (V_{SS-VD}) (Note 1)			20	30	40	mV
Turn-Off Delay (Note 1)	t_{Doff}	V_D =V_{SS}		30	45	ns
Minimum On-Time (Note 1)	t_{MIN}			1.6		us
Light-Load-Enter Delay	$t_{LL-Delay}$			120		us
Light-Load-Enter Pulse Width	t_{LL}			2.2		us
Light-Load-Enter Pulse Width Hysteresis	t_{LL-H}			0.2		us
Light-Load Mode Exit Pulse Width Threshold (V_{DS})	V_{LL-DS}			-250		mv
POWER SWITCH CHARACTERISTICS						
Single Pulse Avalanche Current (Note 2)	I_{AS}			41		A
Single Pulse Avalanche Energy (Note 2)	E_{AS}			250		mJ
Drain-Source On-State Resistance	$R_{DS(ON)}$			9.5	11.4	mΩ
Input Capacitance	C_{iss}	V_{DS}=25V,f=1MHz		3696		pF
Output Capacitance	C_{oss}			258		pF
Reverse Transfer Capacitance	C_{rss}			104		pF
DRAIN-SOURCE DIODE CHARACTERISTICS						
Reverse Recovery Time	t_{rr}	I_F=10A,d_{IF}/d_t=300A/us		29		ns
Diode Reverse Charge	Q_{rr}			80		nC

Notes 1: Guaranteed by Design and Characterization.

2. Starting TJ=25°C, L=0.3mH.

■ OPERATION

The USRC8802 supports operation in discontinuous conduction mode (DCM) and Quasi-Resonant Flyback converters. The internal control circuitry of the USRC8802 controls the integrated MOSFET gate in forward mode and will turn the gate off when the MOSFET current is fairly low.

Blanking

The control circuitry contains a blanking function. When it pulls the integrated MOSFET on/off, it makes sure that the on/off state at least lasts for some time. The turn-on blanking time is 1.6μs, which determines the minimum on-time. During the turn-on blanking period, the turn-off threshold is not totally blanked, but changes to +50mV (instead of -30mV). This ensures that the part can always turn off even during the turn-on blanking period (albeit slower).

Under-Voltage Lockout

When V_{DD} is below the under-voltage lockout (UVLO) threshold, the part enters sleep mode and the integrated MOSFET will not turn on.

Basic Operation

The basic operations of flyback converter with the USRC8802 are:

Turn-On Phase

When the switch current flows through the body diode of the integrated MOSFET, it generates a negative V_{DS} (V_D-V_{SS}) across it (<-500mV); the V_{DS} is much lower than the turn-on threshold of the control circuitry (-70mV), which then turns on the integrated MOSFET after a 200ns turn-on delay .

Conducting Phase

When the integrated MOSFET turns on, V_{DS} ($-I_{SD}$ x $R_{DS(ON)}$) rises according to the switch current (I_{SD}) drop: As soon as V_{DS} rises above the turn-on threshold (-70mV), the control circuitry stops pulling up the internal gate driver and the driver voltage of the integrated MOSFET drops, which makes the MOSFET ON-resistance $R_{DS(ON)}$ larger. By doing that, V_{DS} ($-I_{SD}$ x $R_{DS(ON)}$) stabilizes to around -70mV even when the switch current I_{SD} is fairly small. This function can avoid triggering the turn-off threshold (-30mV) of the internal driver until the current through the integrated MOSFET has dropped to near zero.

Turn-Off Phase

When V_{DS} rises to trigger the turn-off threshold (-30mV), the driver voltage of the switch goes zero after a 20ns turn-off delay by the control circuitry. Similar to turn-on phase, a 200ns blanking time after the switch turns off avoid erroneous trigging.

Light-Load Latch-Off Function

The gate driver of integrated MOSFET in the USRC8802 is latched to save the driver loss at light-load condition to improve light-load efficiency. The light-load-enter pulse width (t_{LL}) is internally fixed at 2.2μs. During each switching cycle, if the integrated MOSFET conducting period remains below 2.2μs, the USRC8802 falls into light-load mode and latches off the integrated MOSFET after a 120μs delay(light-load-enter delay, $t_{LL\text{-}Delay}$)

After entering light-load mode, the USRC8802 monitors the integrated MOSFET's body diode conducting period by sensing V_{DS}—when V_{DS} exceeds -250mV ($V_{LL\text{-}DS}$), the USRC8802 treats the integrated MOSFET as a body diode until the conducting period finishes. If the MOSFET's body diode conducting period is longer than 2.4μs (t_{LL}+$t_{LL\text{-}H}$), the light-load mode finishes and the integrated MOSFET of USRC8802 is unlatched to restart the internal synchronous rectification.

■ TYPICAL APPLICATION