

GENERAL DESCRIPTION

The N3868V is a low cost, high efficiency, full featured, synchronous rectification controller specifically designed for the synchronous rectification applications of the Flyback AC/DC PWM mode switching power supply.

The N3868V includes a totem pole output that ideally suited for driving the synchronous rectification power MOSFET. Two ways of the duty control provide for wide applications by any continuous or discontinuous mode operating. In continuous mode operating, it includes a timing control to adjust maximum turn-on duty to allow the designer to determine the optimal condition for the best efficiency by setting the external resistor and capacitor. In discontinuous mode operating, it collocates with an external current detector N3869V to generate a control signal to control the synchronous rectification MOSFET off earlier before the MOSFET of primary side is turn on, avoid happening a large reverse current via the synchronous rectification MOSFET to damage the device.

FEATURES

- ▲ High efficiency operation
- ▲ Adjustable Max. duty cycle design
- ▲ Decrease areas of heatsink or PCB
- ▲ Solved heat dissipation
- ▲ Suited for continuous and discontinuous mode operation
- ▲ Auto frequency tracking with PWM frequency
- ▲ Suited for fixed or variable frequency
- ▲ SOP-8 package

APPLICATION

- Flyback mode power supply

ABSOLUTE MAXIMUM RATING

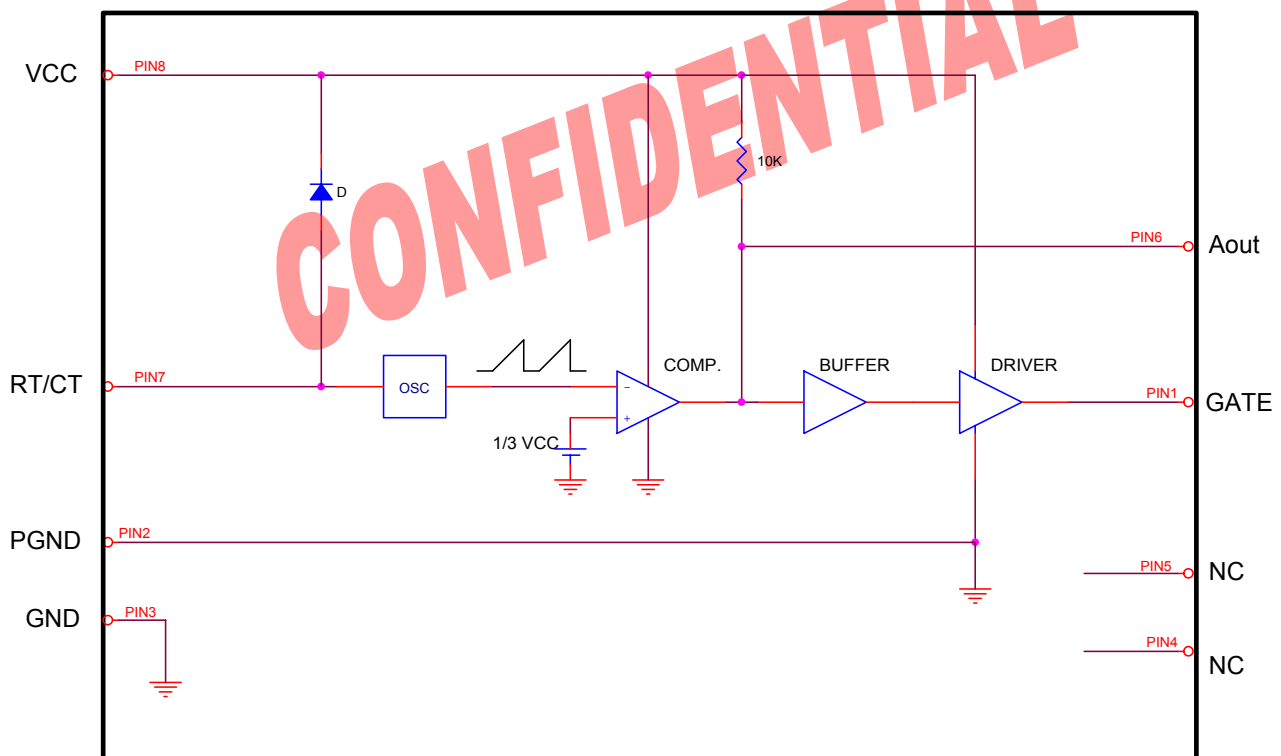
PARAMETERS	SYMBOL	LIMITS	UNITS
VCC to GND	VCC	-0.3 to 30	V
*VCC to GND	VCC(surge)	45	Vp-p
Power Dissipation at Ta = 25 °C, Derate 8mW/°C for Ta > 25	PD	725	mW
Operating Junction Temperature Range	Tj	-40 to +150	
Storage Temperature Range	TSTG	-65 to +150	
Lead Temperture(Soldering) 10 sec	TLEAD	300	

*Remark: The width of surge voltage is defined under 300nS.

ELECTRICAL CHARACTERISTICS ($T_c = 25\text{ }^\circ\text{C}$)

PARAMETER	TEST CONDITIONS	LIMITS			UNIT
		MIN	TYP	MAX	
Supply Voltage	VCC	7	12	30	V
Supply Current		-	4.5	-	mA
GATE Sink Current			1		A
GATE Source Current			1		A
Rise Time	CL= 1.0nF		40		nS
Fall Time	CL= 1.0nF		40		nS
Delay Time			300	400	nS
Max Duty Cycle		90	95		%

BLOCK DIAGRAM



OPERATION DESCRIPTION

•Discontinuous mode

In discontinuous mode application, the N3868V collocates with an external current detector N3869V for detecting the MOSFET current, controlling the MOSFET to be ON or OFF status. In discontinuous mode, the current of the secondary output winding flows through the Source and Drain of the MOSFET is changing from maximum level to zero, It cause a voltage drop of the MOSFET proportional decreasing from the maximum level down to zero, the external current detector N3869V generate a control signal to control the synchronous rectification MOSFET off earlier before the MOSFET of primary side is turn on, avoid happening a large reverse current via the synchronous rectification MOSFET to damage the device.

For the various MOSFET applications, different $R_{DS(ON)}$ will cause a different voltage drop between the MOSFET's Source and Drain. The external current detector provides BIAS pin control the voltage slope of Gate for delaying turn-off the MOSFET for better efficiency, the BIAS pin is connected a resistor with VCC, change the resistance will get different slope, a higher resistance will get smoother slope, and MOSFET turn-off become slower, a smaller resistance will get sharper slope, and MOSFET turn-off become quicker.

Considering of Bias setting, first, adjust output to heavy load but still in discontinuous mode, changing the Bias resistor make the Gate waveform of MOSFET is sloping to connect the resonant waveform of LC tank of the output circuit, second, adjust output to the minimum load and check the Gate waveform is OK or not. Otherwise, decrease the resistance until waveform is normal.

•Continuous mode

In continuous mode application, the current detector N3869V can not turn-off the MOSFET directly, the N3868V provides the "maximum duty control" function to turn off the power MOSFET by RT/CT pin, The N3868V is set in the low line AC input voltage and maximum loading to adjust RTor CT to determine the maximum duty and timely turn off the MOSFET. Another control is using a synchronous signal from the primary side to control the AOUT pin, pull the AOUT pin to low will turn off the output of Gate driver. AOUT pin also can be used to increase Gate driving capability when two parallel MOSFET application, connected a resistor to VCC if need.

TYPICAL APPLICATION CIRCUIT

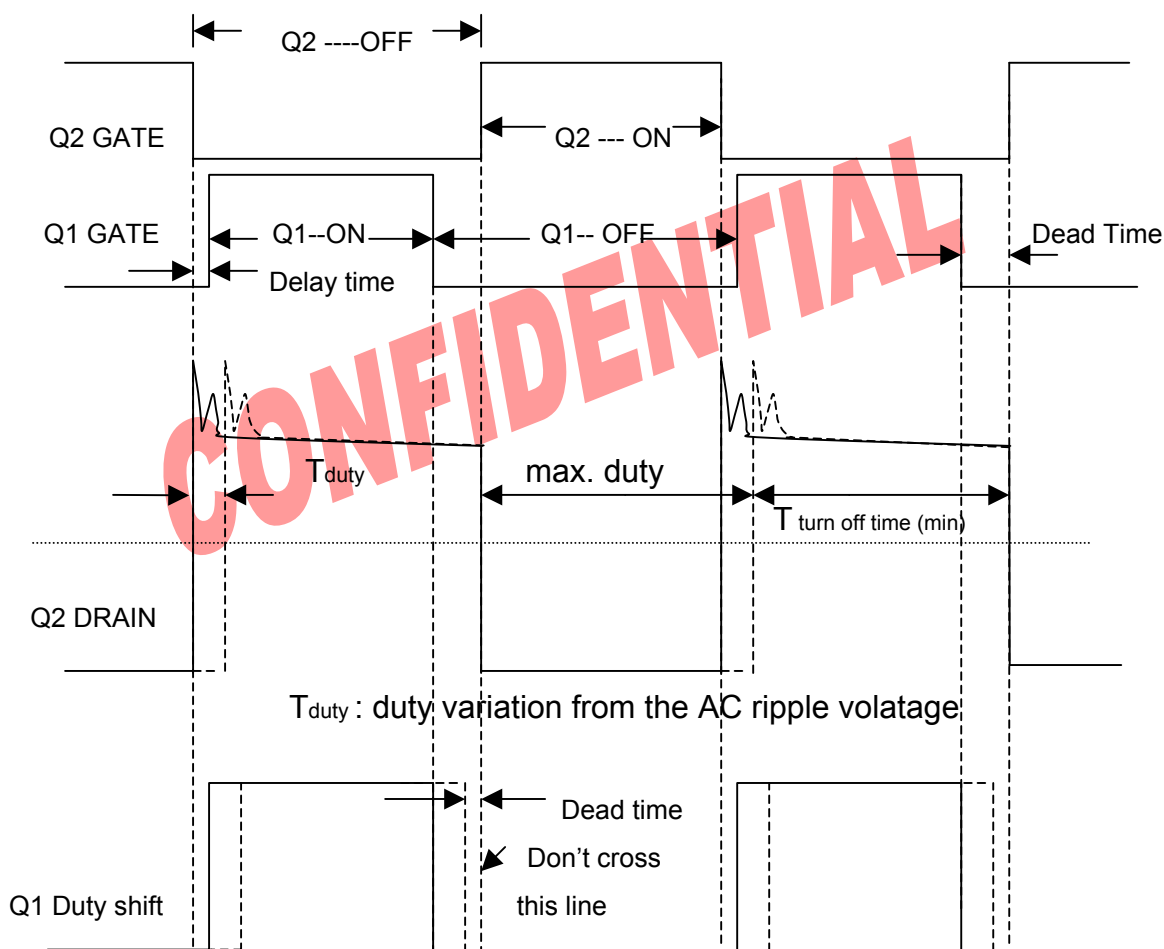
a. Without primary synchronous signal application

The N3868V without primary synchronous signal application is designed for a low cost flyback power supply . The structure is suggested to operate in discontinuous mode for high line input voltage and low line input voltage in continuous mode that can get better efficiency for full input range design .

In this structure, to select small tolerance(1~2%) of some componets will be necessary, such as RT/CT of N3868V, and the frequency componets R_t / C_t of the primary PWM controller . Otherwise , it may cause primary and secondary MOSFET turn-on at same time.

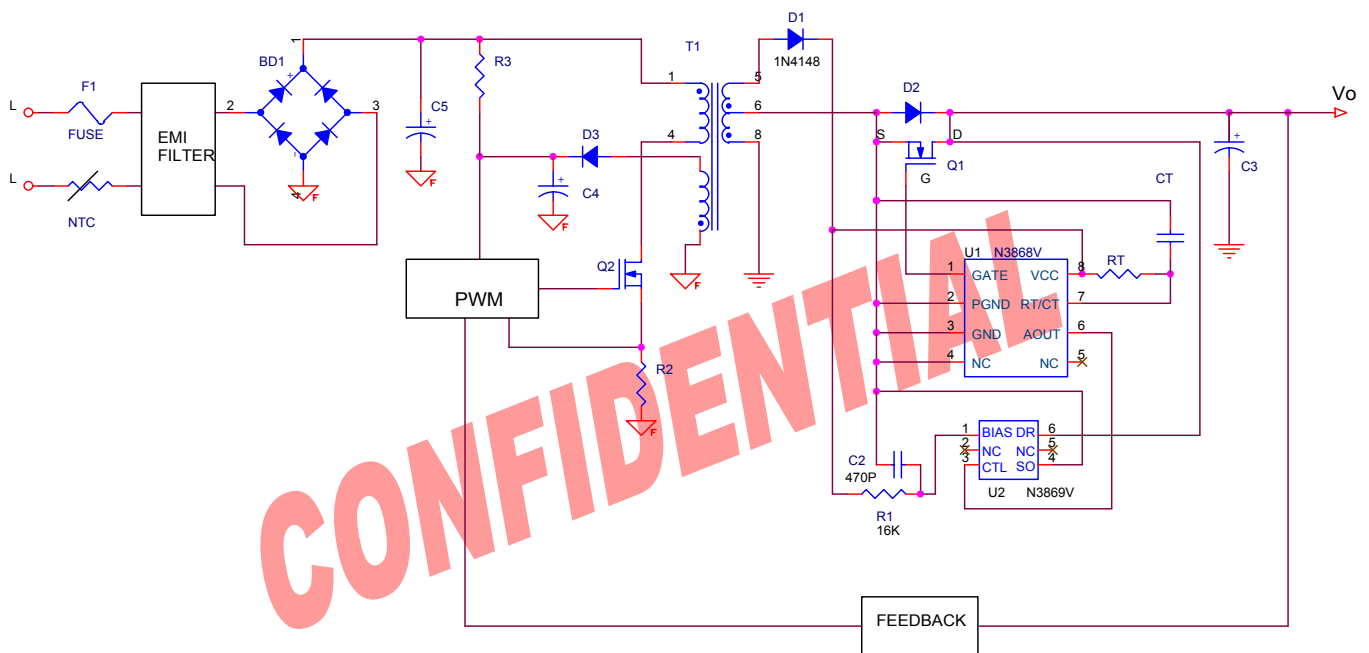
$$\text{Dead time} = T_{\text{turn off time (min)}} \times (\text{Total Tol.}\%) + t_{d(\text{off})} \text{ of S.R. MOSFET}$$

$$\text{Total Tol.}\% = (R_t + C_t + R_T + C_T) \text{Tol.}\%$$



Schematic 1 is N3868V without primary synchronous signal application , in which the AUX winding is designed to provide the supply voltage about 10V ~15V , the supply voltage via the rectified diode D1 to VCC of the N3868V without any capacitor .

In the continuous mode, to change the values of the external resistor RT and capacitor CT that can set the fixed maximum turn-on duty for the synchronous rectification MOSFET. In the discontinuous mode , the external current detector N3869V is sensing the voltage drop of the MOSFET , if it is under 20mV ,then decreases the Gate voltage to turn off the MOSFET .

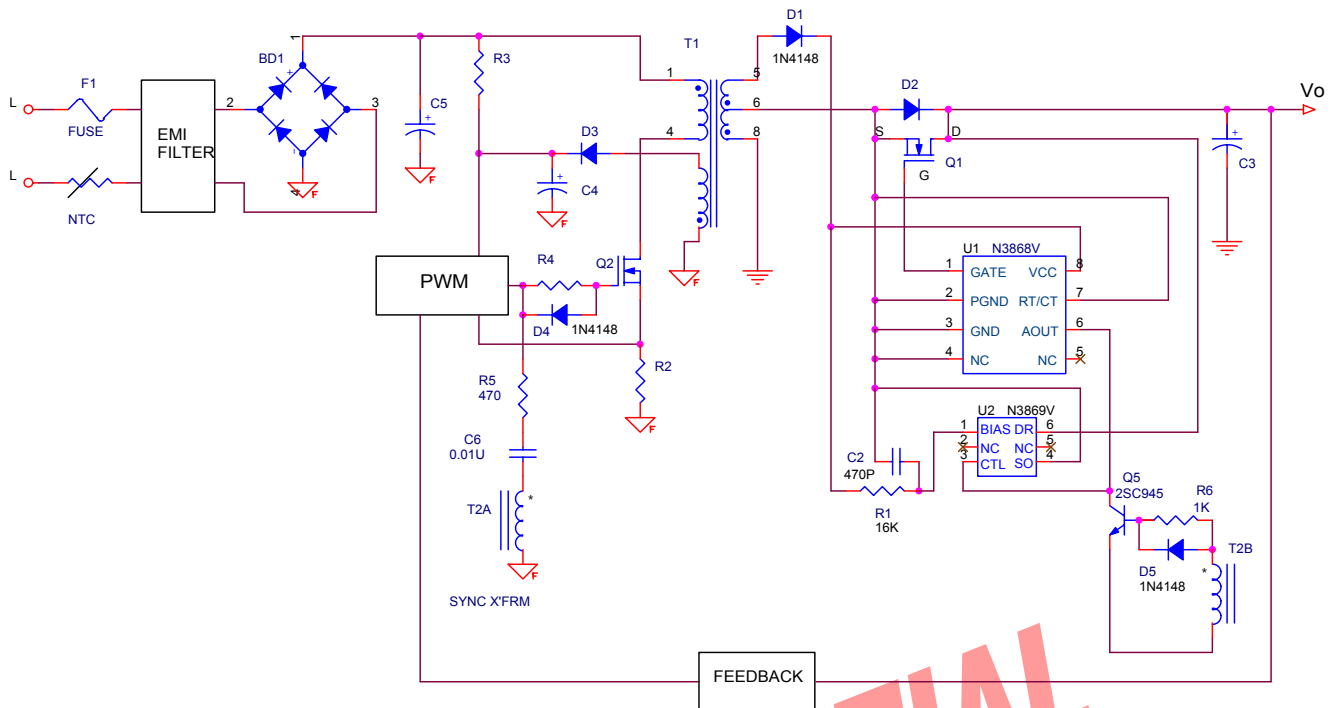


Schematic 1 N3868V without primary synchronous signal application

b. With primary synchronous signal application

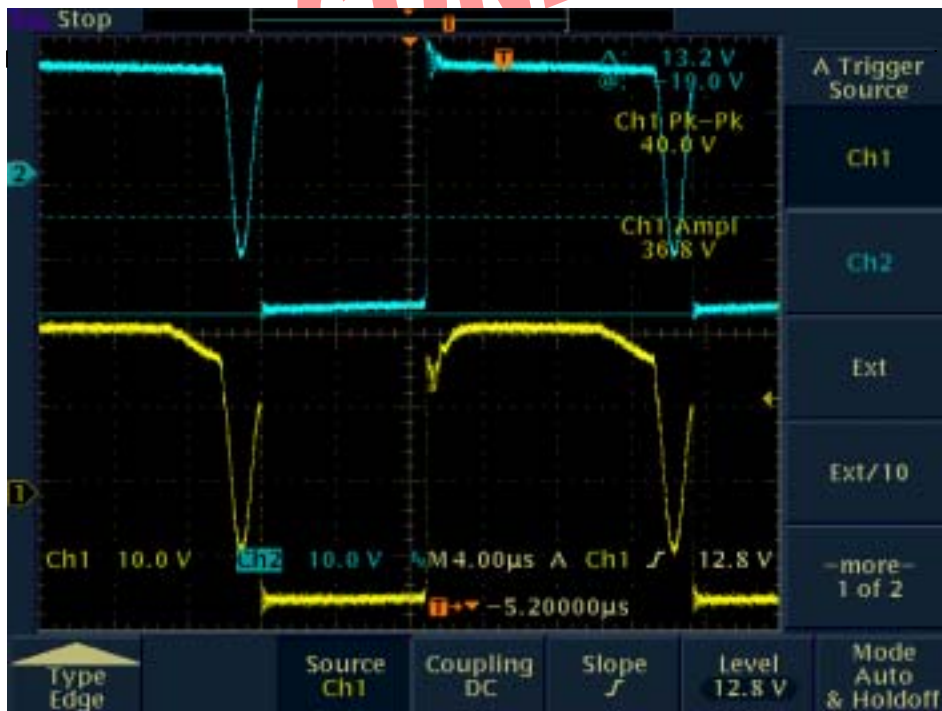
The structure is designed for a high power output and high performance flyback power supply , the synchronous signal is provided from the output of the PWM controller before primary power MOSFET Q2 turning on , it need to use a isolation type transformer between the primary and the secondary for safety request .when the circuit is working in continuous mode , the MOSFET of the secondary side to be turned off by a synchronous signal from the primary side , if works in discontinuous mode that turned off by the current detector N3869V to sense the voltage drop between the source and drain of the MOSFET .

Schematic 2 is N3868V with primary synchronous signal type application, in this application , the pin 7 is connected to pin 3 of this IC to disable the maximum turn on duty function because the MOSFET can get best control from the primary synchronous signal .

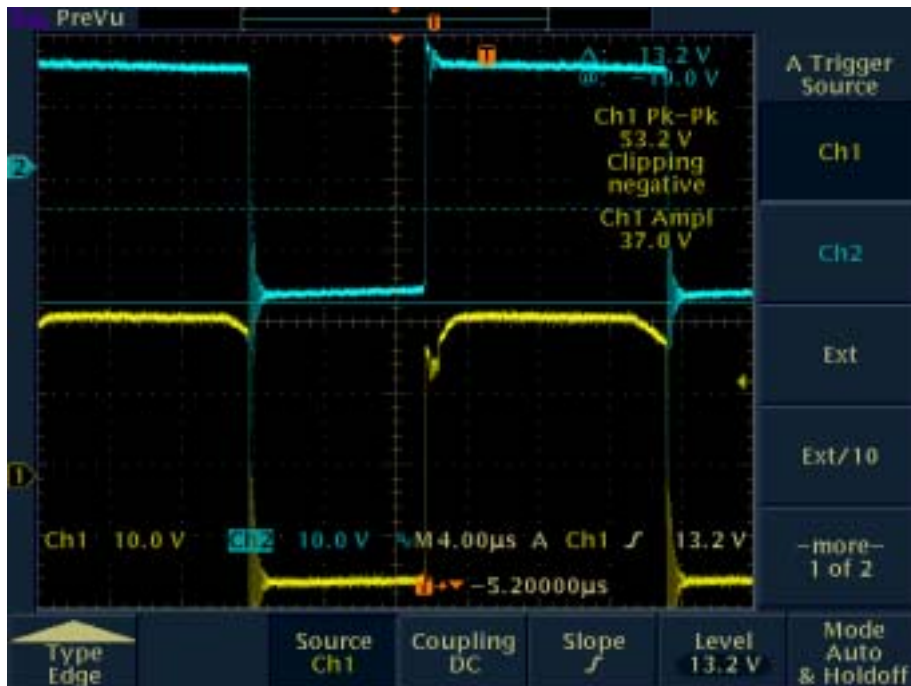


Schematic 2 N3868V with primary synchronous signal application

TYPICAL CHARACTERISTICS



pic.1 secondary winding output and gate voltage of MOSFET waveform at discontinuous mode condition .

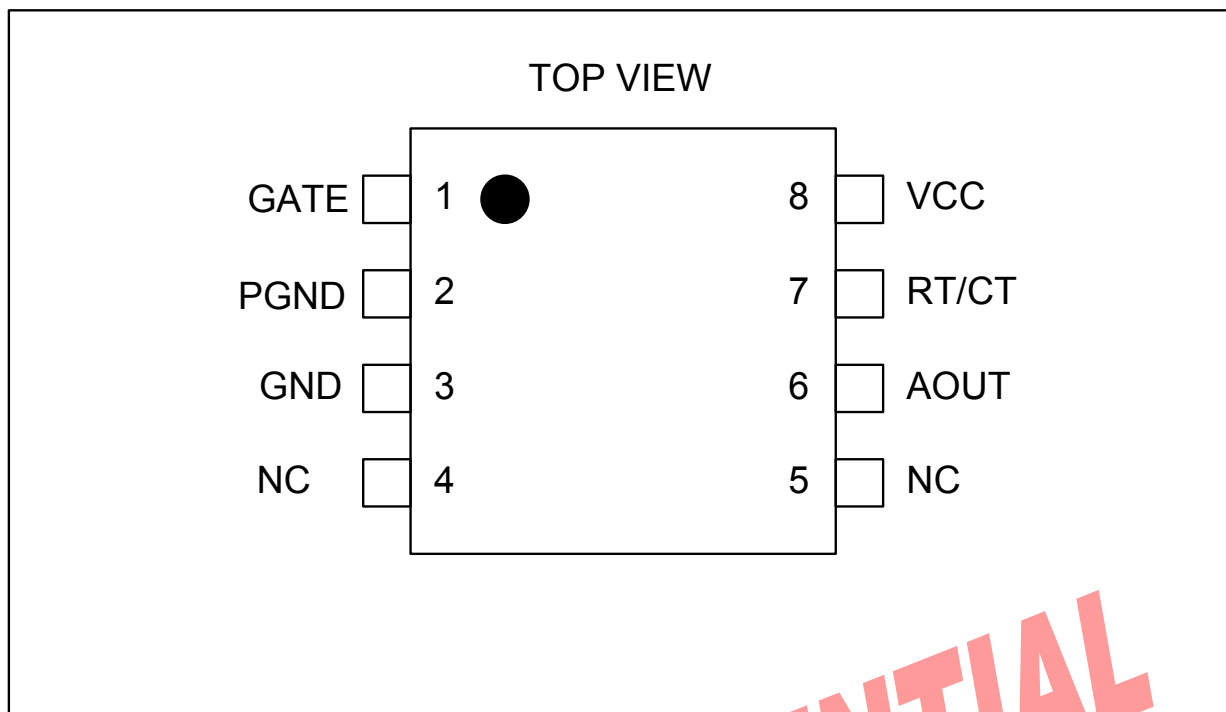


pic.2 secondary winding output and gate voltage of MOSFET waveform at continuous mode condition .



pic.3 secondary winding output and gate voltage of MOSFET waveform at no load condition .

PIN CONFIGURATIONS



CONFIDENTIAL

PIN FUNCTIONS

NO.	FUNCTION	DESCRIPTION
1	GATE	This pin is the output pin to drive the gate of the power MOSFET.
2	PGND	This pin is to POWER GND for output drive circuit.
3	GND	This is signal GND pin for the control logic signals.
4	NC	Not used.
5	NC	Not used.
6	AOUT	This pin is internal comparator output to control "pin1" output duty.
7	RT/CT	This pin is connected an external resistor and capacitor to set the fixed maximum turn-on duty.
8	VCC	This pin is for supply voltage.

SOP-8 MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.70	4.90	5.10	H	0.40	0.715	0.83
B	3.70	3.90	4.10	I	0.19	0.22	0.26
C	5.80	6.00	6.20	J	0.25	0.375	0.5
D	0.33	0.445	0.51	K	0°	4°	8°
E		1.27		L			
F	1.20	1.375	1.62	M			
G	0.08	0.175	0.28	N			

