GENERAL DESCRIPTION

The N3866 is a low cost, high efficiency, full featured , synchronous rectification controller that specifically designed for the synchronous rectification applications of the Flyback AC/DC PWM mode switching power supply .

The N3866 is included a totem pole output, ideally suited for driving a synchronous rectification power MOSFET . 2 way of the current detect provided for wide applications by any continuous or discontinuous mode operating.

In continuous mode operating, it included a adjustable constant dead time control to adjust optimal dead time for the best efficiency by the external resistor and capacitor.

In discontinuous mode operating, it included a very sensitive current detector (about 20mV) to control the synchronous rectification MOSFET, avoid happening a large reverse current via the synchronous rectification MOSFET to damage the device.

FEATURES

▲High efficiency operating.

▲Adjustable constant dead time control.

▲Auto turn off output if V_{SD} < 20mV

▲Decrease areas of heatsink or PCB.

▲Solved heat dissipation.

▲Sensitive current detector (about 20mV)

▲Suited for continuous and discontinuous mode operation.

▲Auto frequency tracking with PWM frequency.

▲Suited for fixed or variable frequency

▲SOP-8 and DIP-8 package.

APPLICATION

■Flyback AC/DC power supply

DEVICE SELECTION GUIDE

DIP-8		SOP-8	
SnPb	**Pb Free**	**SnPb**	**Pb Free**
N3866P	N3866PG	N3866V	N3866VG

ABSOLUTE MAXIMUM RATING

PARAMETERS	SYMBOL	LIMITS	UNITS
Vcc to GND	Vcc	-0.3 to 30	V
V_{DD} to GND	V_{DD}	-0.3 to 30	V
Drain to Other Pin		180	V
Power Dissipation at Ta = 25 ,Derate 8mV/ for Ta 25	P_D	725	mW
Operating Junction Temperature Range	Tj	-40 to +150	
Storage Temperature Range	T_{STG}	-65 to +150	
Lead Temperture(Soldering) 10 sec	T_{LEAD}	300	

REV : 2

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ELECTRICAL CHARACTERISTICS (T_C = 25 °C)

PARAMETER	SYMBOL	TEST CONDITIONS	LIMITS			UNIT
			MIN	TYP	MAX	
Supply Voltage (peak to peak)	Vcc		7	12	30	V
Supply Voltage (DC voltage)	V_{DD}		7	12	30	V
Supply Current	Icc		-	5	-	mA
Reference Voltage	VREF	Vcc= 7~30V	4.95	5.00	5.05	V
GATE Sink Current	I_{sink}	C_L= 1.0nF		1.5		A
GATE Source Current	I_{source}	C_L= 1.0nF		1.5		A
Rise Time	t_r	C_L= 1.0nF		40		nS
Fall Time	t_f	C_L= 1.0nF		40		nS
Delay Time				200	300	nS
Max Duty Cycle			90	95		%

BLOCK DIAGRAM

REV : 2
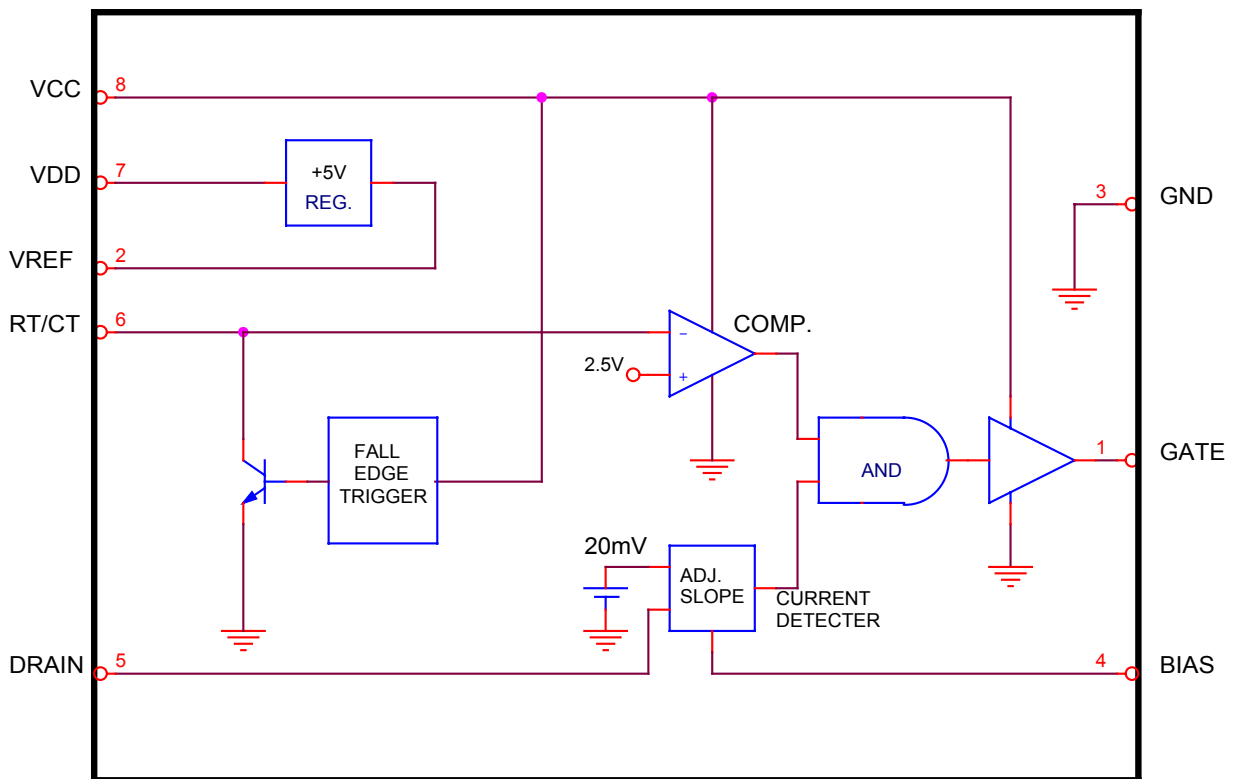
OPERATION DESCRIPTION

•**Discontinuous mode**

In discontinuous mode application, the N3866 is detecting the MOSFET current to control the MOSFET be ON or OFF by a internal current detecter , in discontinuous mode , the current of the secondary 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 from the maximum level down to zero , the voltage drop is compared with internal reference voltage 20mV, if voltage dropout is over 20mV ,will make the MOSFET turn-on, if the voltage drop is under 20mV, will make the MOSFET become turn-off.

For the various MOSFET applications , different $R_{DS(ON)}$ will cause a different voltage drop between the MOSFET,s Source and Drain , the BIAS pin provided the "adjustable slope" function delaying turn-off the MOSFET for better efficiency , BAIS pin connected a resistor with VCC used to adjust the gate output slope , change the resistance will get the different slope ,a higher resistance will get the smoother slope, and MOSFET turn-off become slower , a smaller resistance will get the 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 , to decrease the resistance until waveform is normal .

•**Continuous mode**

In continuous mode application , the current detecter can not turn-off the MOSFET directly, the N3866 provided a adjustable constant dead time control dead time circuit for adjusting the optimal dead time and timely turn off the MOSFET by the external RT and CT,

•**Constant dead time control**

The RT/CT pin is connected a   RT and CT   to adjust a optimal dead time to   prevent   the synchonous rectification MOSFET and the forward rectification MOSFET working on-state condition when during fly-whelling period is ended.If RT and CT fixed,however AC input or duty cycle is changing then the dead time will be fixed to be constant.

In this structure, to seclect small tollerence(1~2%) of some componets will be necessary, such as RT/CT of N3866 ,and the frequency componets Rt / Ct of the PWM controller . Otherwise , it may cause Q1and Q2 turn-on at same time.

$$f_{(osc)} \approx \frac{1.44}{R_T C_T}$$

REV : 2

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$$\text{Dead time(max)} = T_S \times \text{Total Tol.\%} + t_{d(off)} \text{ of S.R. MOSFET} \quad , \quad T_S = 1/f_S$$

$$\text{Dead time(min)} = t_{d(off)} \text{ of S.R. MOSFET} \quad , \quad \text{Total Tol.\%} = (Rt + Ct)\text{Tol.\%}$$

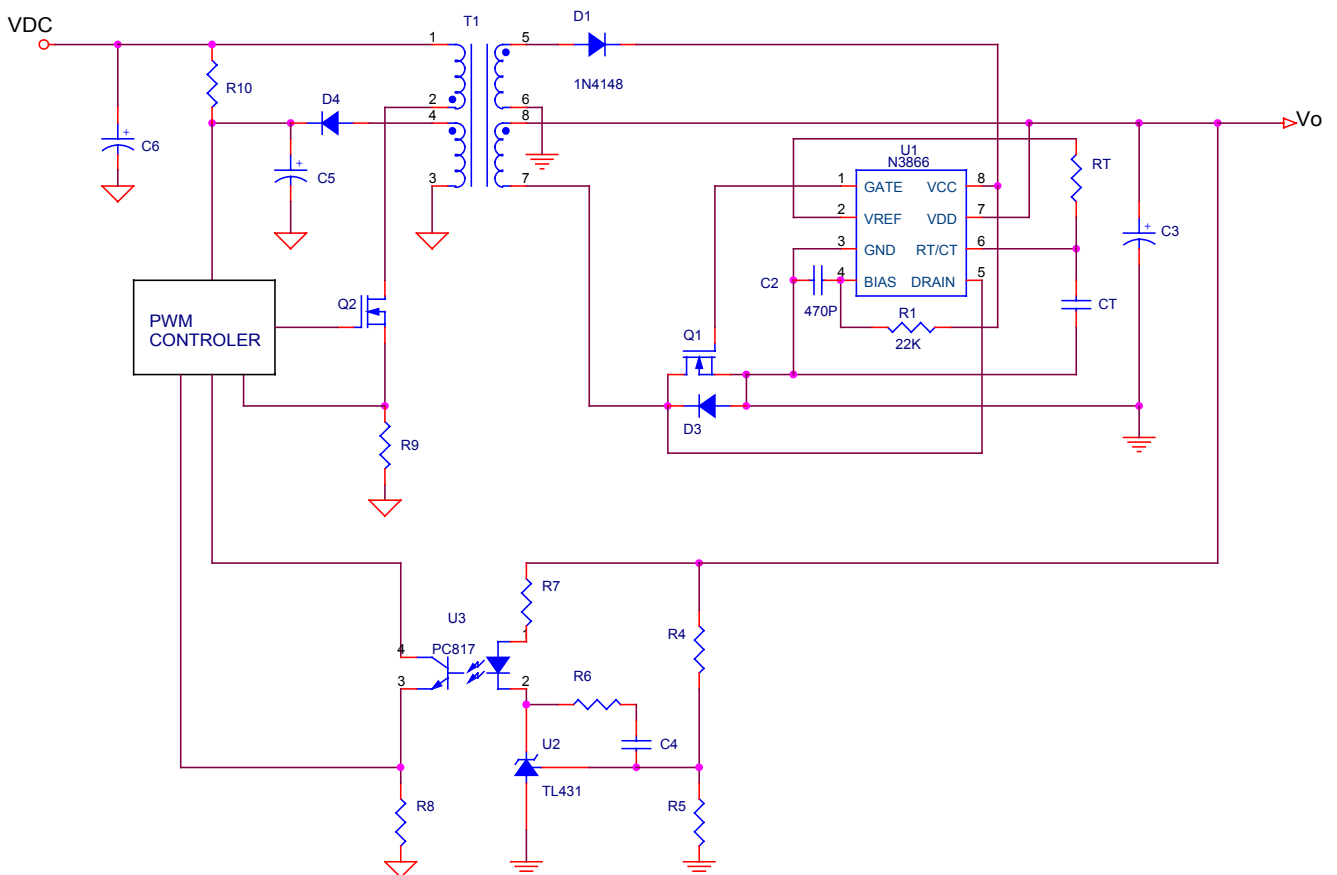## TYPICAL APPLICATION CIRCUIT

Typical high side application

Schematic1 is N3866 typical high side application for flyback converter , the synchonous rectification MOSFET is placed on the output pin of output winding ,and a AUX winding connects on the output winding , the AUX winding is designed to provide the supply voltage about 10V ~15V.
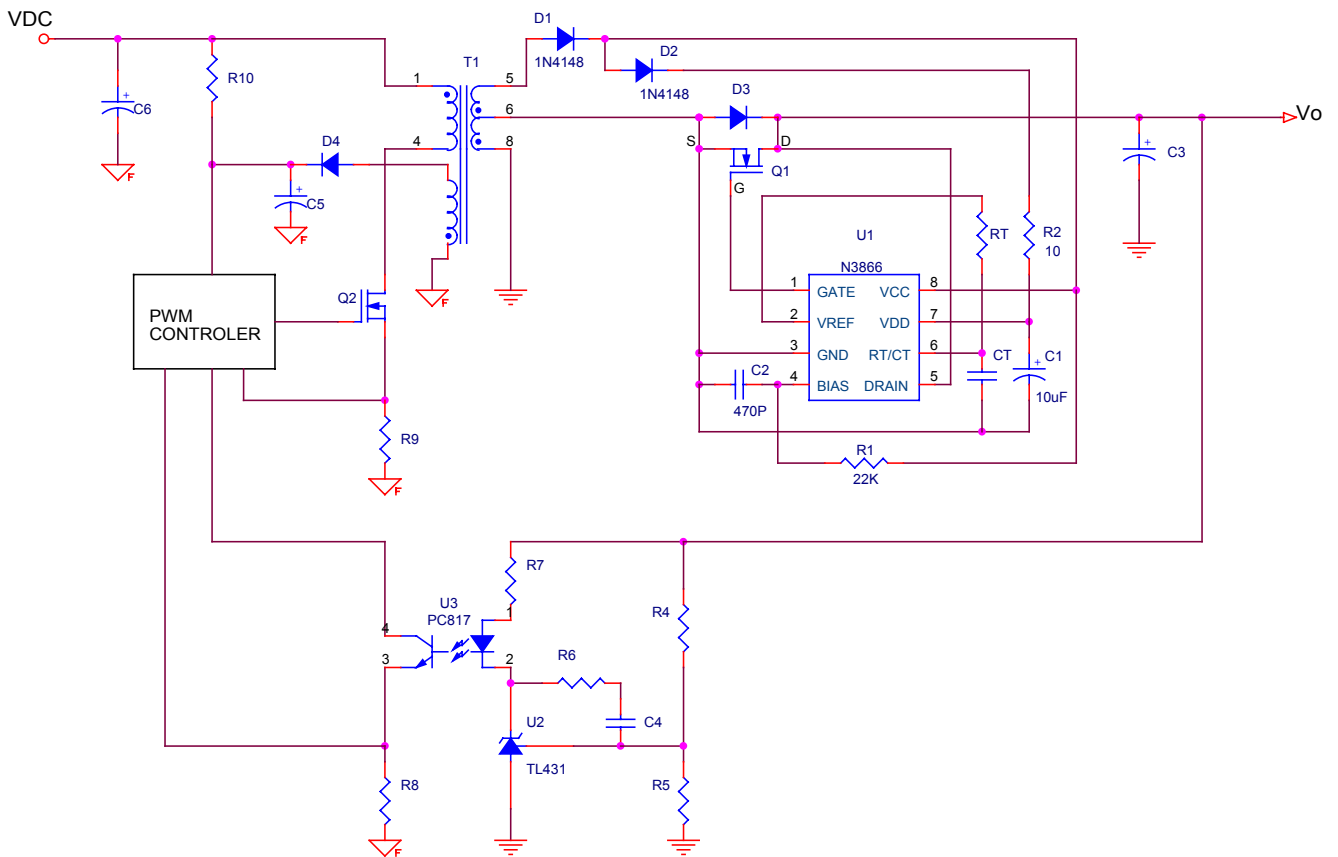
Schematic 1   N3866 typical high side application for flyback converter

Typical low side application

Schematic 2 is N3866 typical low side application for flyback converter , the synchonous rectification MOSFET is placed on the return pin of output winding , the AUX winding connection is different to schematic 1 , the AUX winding is designed to provide the supply voltage about 10V ~15V.

Schematic 2   N3866 typical low side application for flyback converter
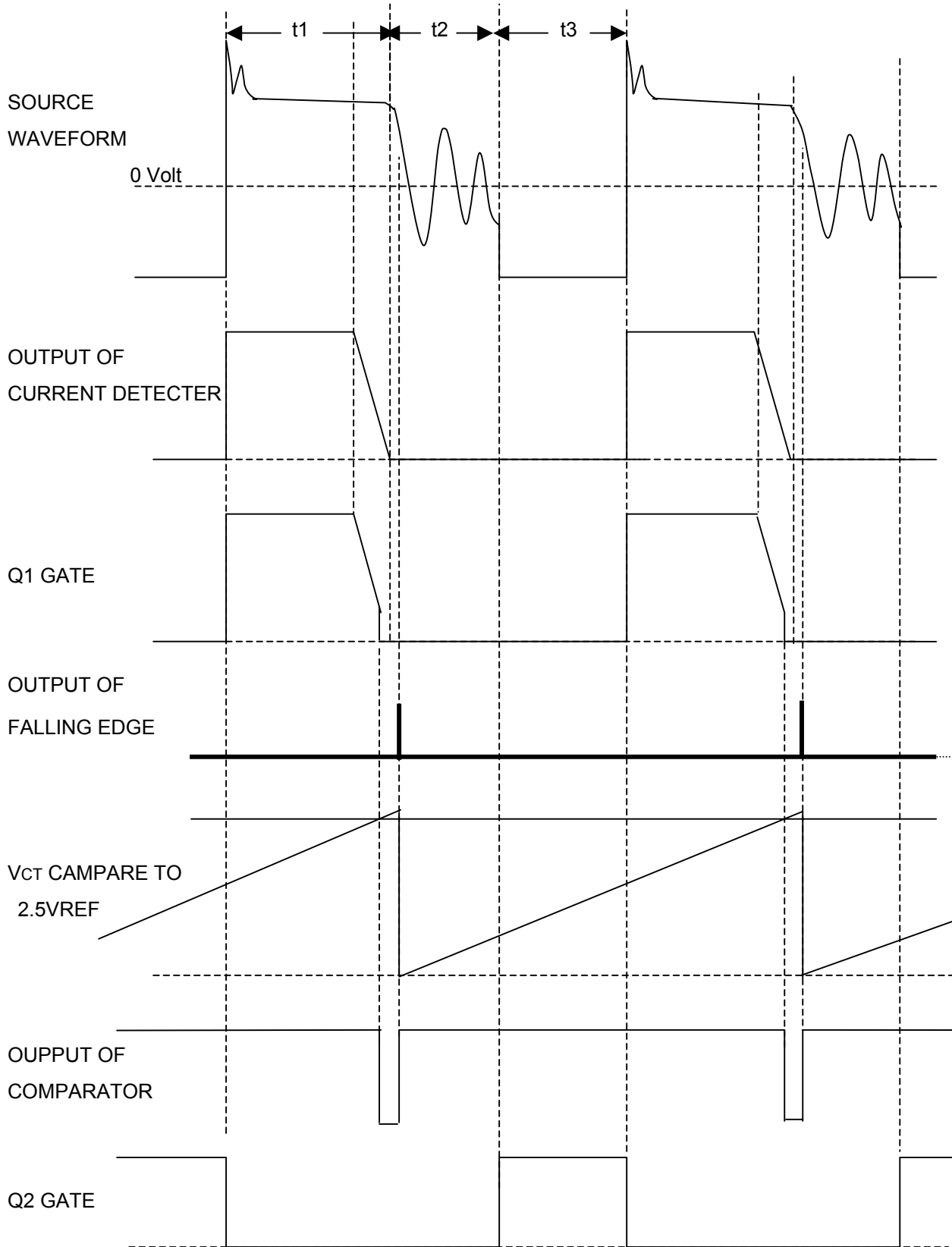
CONTROL WAVEFORM

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SOURCE
WAVEFORM

0 Volt

OUTPUT OF
CURRENT DETECTER

Q1 GATE

OUTPUT OF
FALLING EDGE

V_{CT} CAMPARE TO
2.5VREF

OUPPUT OF
COMPARATOR

Q2 GATE

FIG 1. discontinuous mode operating waveform

REV : 2

SOURCE WAVEFORM

0 Volt

t1   t3   t2=0

DUTY1

DUTY2

OUTPUT OF CURRENT DETECTER

OUTPUT OF FALLING EDGE TRIGGER

2.5VREF

VCT COMPARE TO 2.5VREF
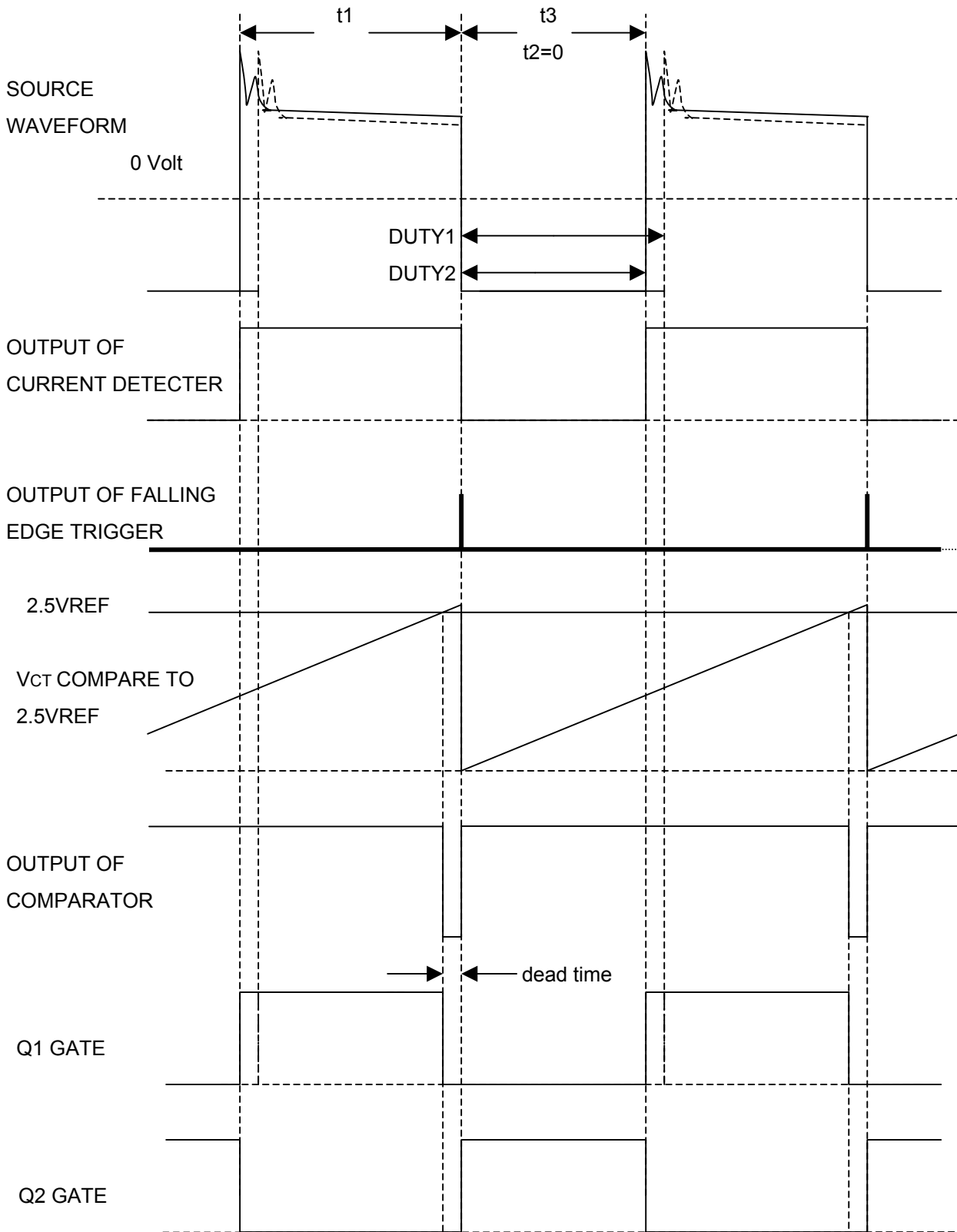
OUTPUT OF COMPARATOR
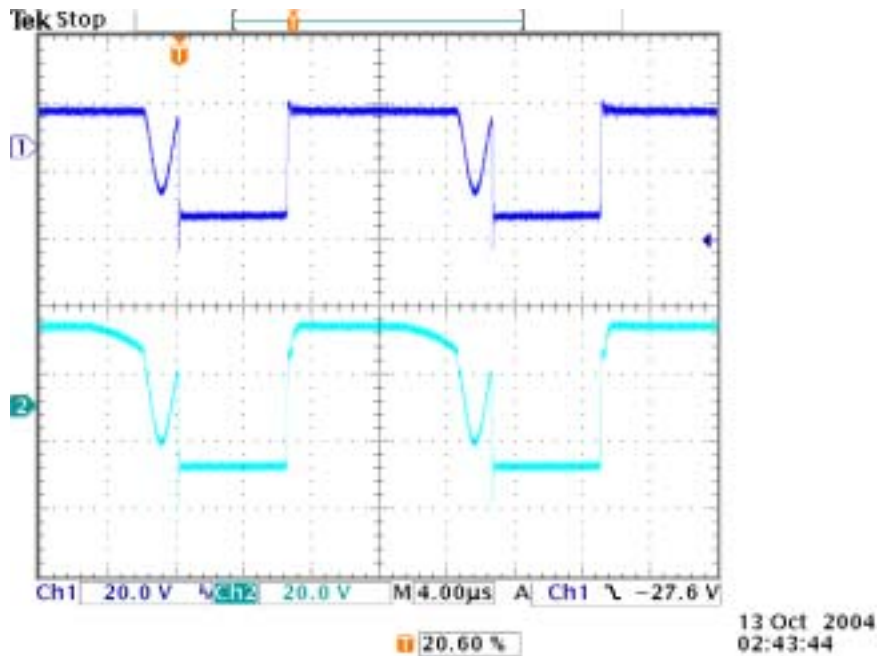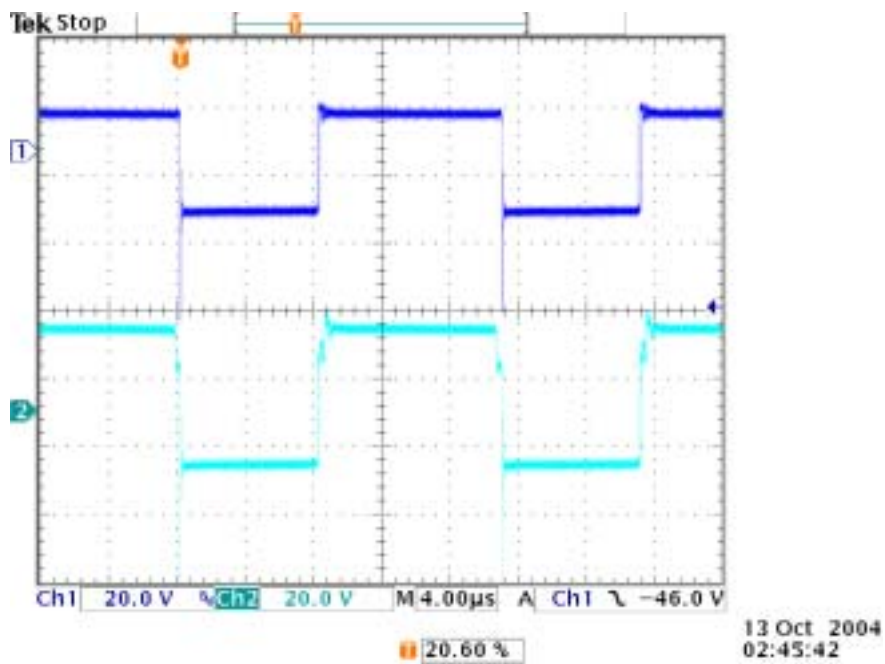
dead time

Q1 GATE

Q2 GATE

FIG 2. continuous mode operating waveform
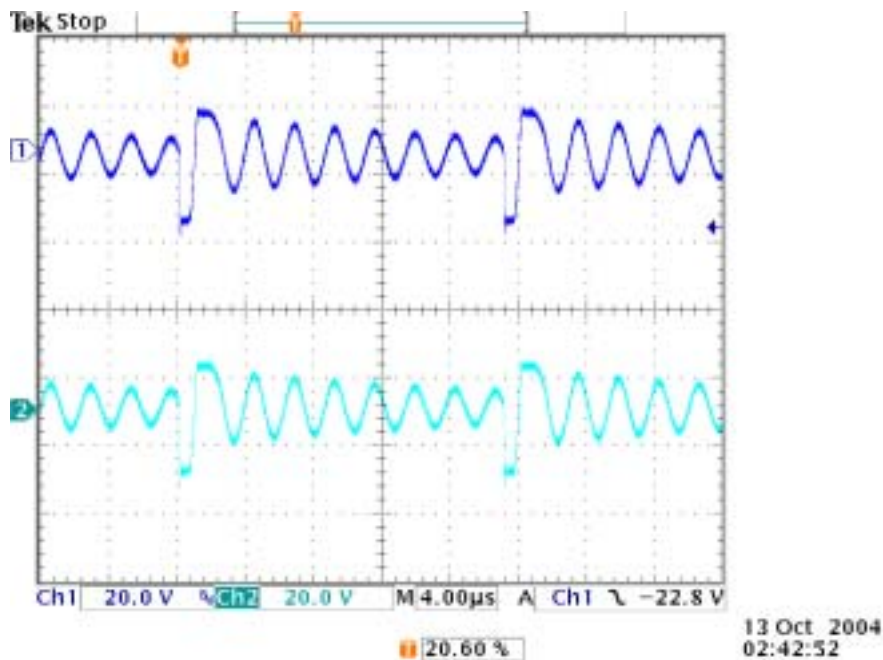
TYPICAL CHARACTERICS

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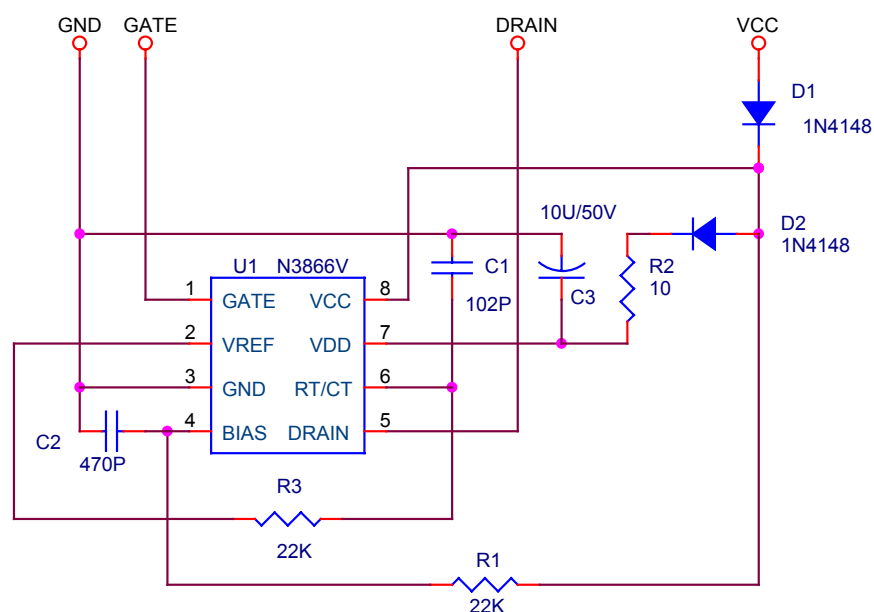

**pic.2   secondary winding output and gate voltage of MOSFET waveform
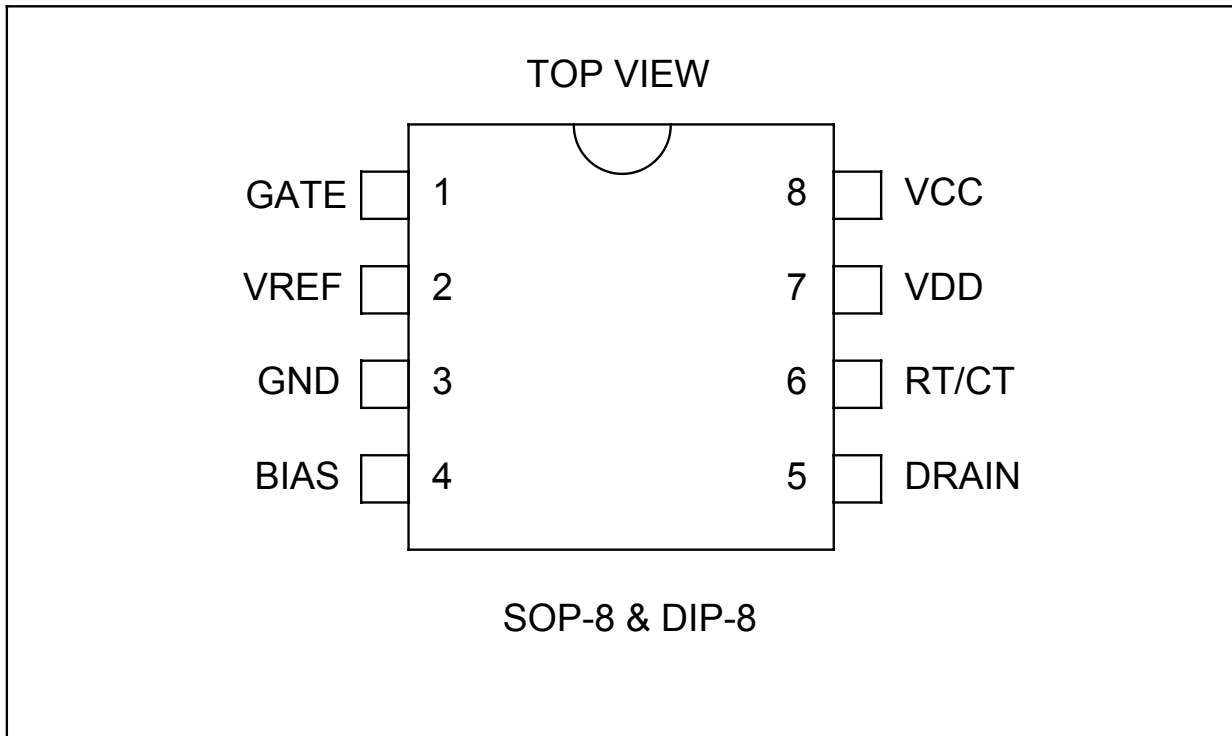   at continuous mode condition .**

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

DEMO BOARD DESCRIPTION

The Schematic 2   presents a demo board for the N3866V , This board replaces the output
rectifier diode with synchronous rectification MOSFET in flyback power supply and includes
all the components needs by the N3866V to operate, R3 and C1 can be adjusted a constant
dead time for diffferent switching frequency .

REV : 2

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PIN CONFIGURATIONS

TOP VIEW

```
         ┌──────────┐
GATE ─┤ 1        8 ├─ VCC
VREF ─┤ 2        7 ├─ VDD
 GND ─┤ 3        6 ├─ RT/CT
BIAS ─┤ 4        5 ├─ DRAIN
         └──────────┘
```

SOP-8 & DIP-8

PIN FUNCTIONS

NO.	FUNCTION	DESCRIPTION
1	GATE	This pin is the output pin to drive the gate of the power MOSFET.
2	VREF	5V reference voltage output, it provides charging current for C_T through R_T .
3	GND	This is signal GND pin for the control logic signals .
4	BIAS	This pin is bias voltage supply for the internal current detecter .
5	DRAIN	Input pin of the internal current detecter , connect to drain of MOSFET .
6	RT/CT	This pin is connected a external resistor Rt and capacitor CT to generate a constant sawtooth waveform .
7	VDD	This pin is the supply voltage for internal 5V regulator .
8	VCC	This pin is the supply voltage for control and driver circuit.

REV : 2

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DIP-8 MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	8.8		9.6	H	7.95		9.75
B	6.2		7.0	I			
C	0.35	0.45	0.55	J			
D		2.54		K			
E	0.5		0.8	L			
F	3.05	3.28	3.56	M			
G	7.48	7.62	8.13	N			

REV : 2
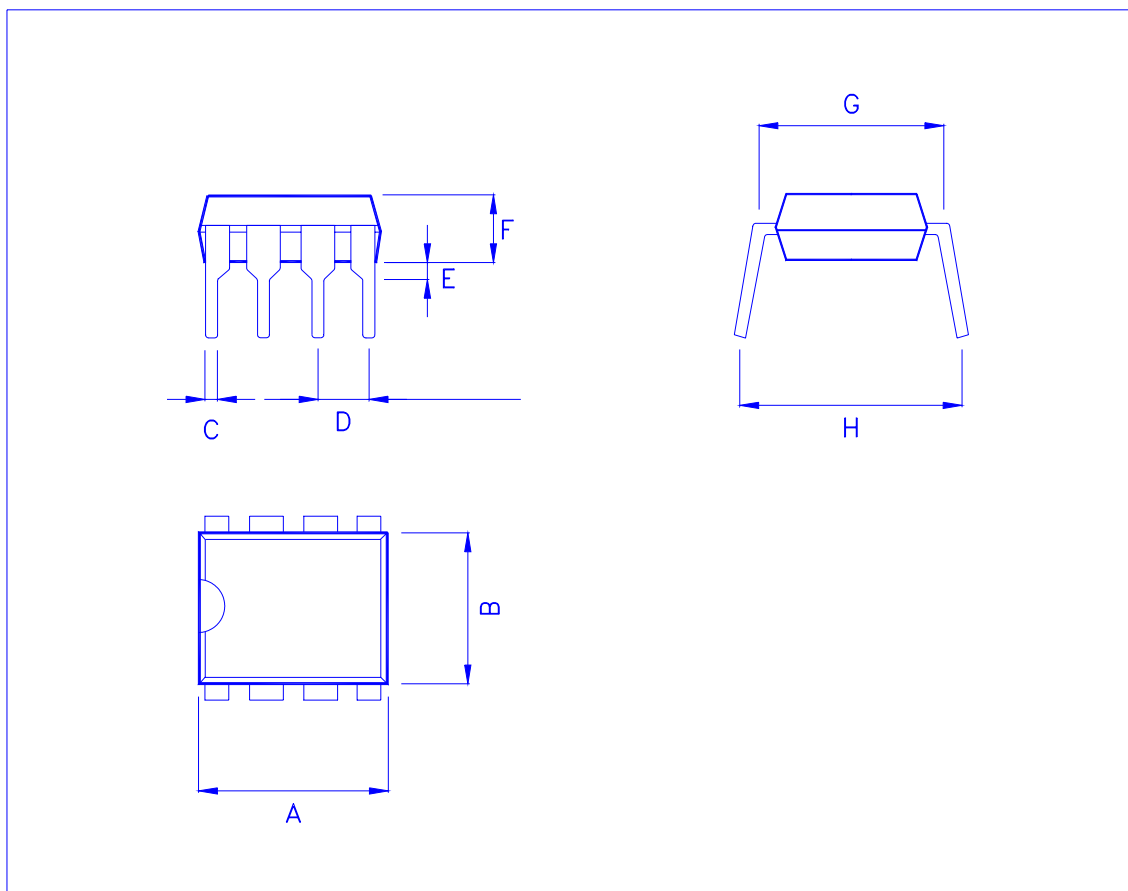
SOIC-8 (D) MECHANICAL DATA

Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.8	4.9	5.0	H	0.5	0.715	0.83
B	3.8	3.9	4.0	I	0.18	0.254	0.25
C	5.8	6.0	6.2	J		0.22	
D	0.38	0.445	0.51	K	0°	4°	8°
E		1.27		L			
F	1.35	1.55	1.75	M			
G	0.1	0.175	0.25	N			