

**GENERAL DESCRIPTION**

The N3858 is a low cost, high efficiency, full featured, synchronous rectification controller that specifically designed for the synchronous rectification applications of the forward AC/DC PWM mode switching power supply.

The N3858 is included two of totem pole outputs ideally suited for driving a forward rectification power MOSFET and a fly-wheeling synchronous rectification power MOSFET. It provided fully applications by any continuous or discontinuous mode operating (patent pending) and wide range AC input (90V~264V) operating.

It built a trimming 5V regulator to supply the internal reference voltage and a external 5V reference voltage output.

**FEATURES**

- ▲ High efficiency operating.
- ▲ Adjustable constant dead time control.
- ▲ Two of totem pole driver outputs
- ▲ Decrease areas of heatsink or PCB.
- ▲ Solved heat dissipation.
- ▲ Suited for continuous and discontinuous mode operation.
- ▲ Auto frequency tracking with PWM frequency.
- ▲ SOP-8 and DIP-8 package.

**APPLICATION**

- Forward AC/DC power supply

**ABSOLUTE MAXIMUM RATING**

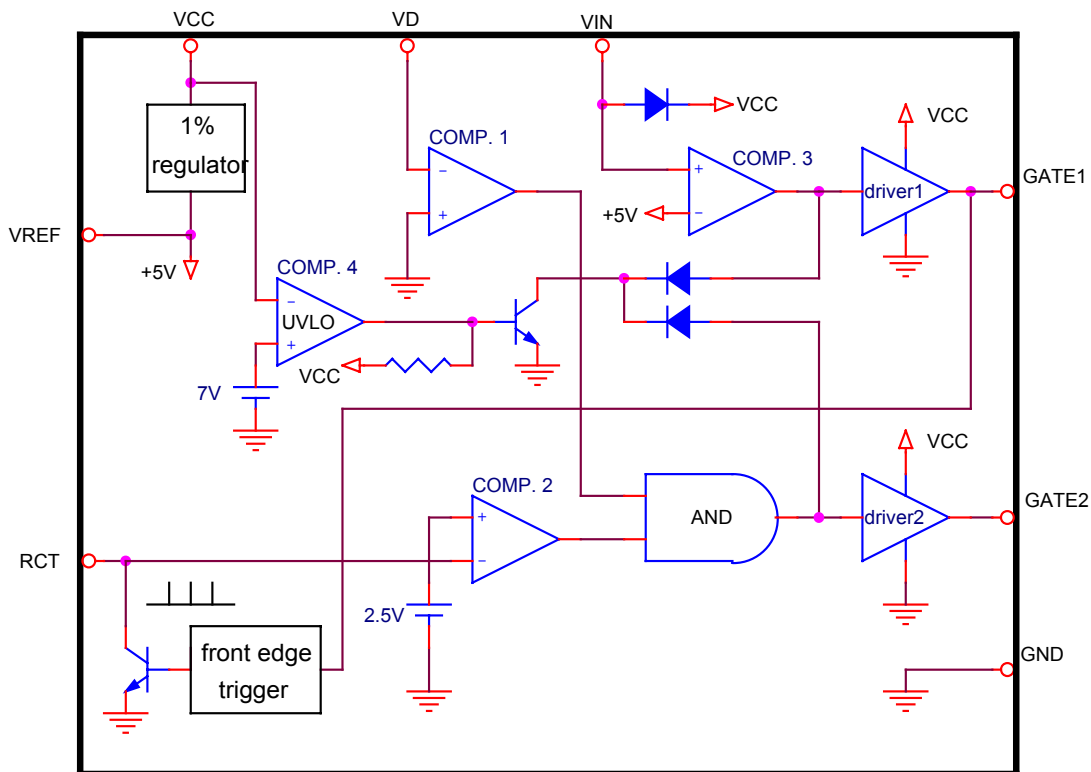
PARAMETERS	SYMBOL	LIMITS	UNITS
Vcc to GND	Vcc	-0.3 to 30	V
VD to Other Pin		180	V
Power Dissipation at Ta = 25 °C, Derate 8mW/°C for Ta > 25 °C	Pd	725	mW
Operating Junction Temperature Range	Tj	-40 to +150	
Storage Temperature Range	TSTG	-65 to +150	
Lead Temperture(Soldering) 10 sec	TLEAD	300	

**ELECTRICAL CHARACTERISTICS (Tc = 25 °C)**

PARAMETER	SYMBOL	TEST CONDITIONS	LIMITS			UNIT
			MIN	TYP	MAX	
Supply Voltage	Vcc		7	12	30	V
Supply Current	Icc	VIN = 0V	-	11	-	mA
Reference Voltage	VREF	Vcc=7~30V	4.95	5.00	5.05	V
GATE1,2 Sink Current	Isink	CL= 1.0nF		1		A
GATE 1,2 Source Current	Isource	CL= 1.0nF		1		A
Rise Time	tr	CL= 1.0nF		40		nS

Fall Time	tr	CL= 1.0nF		40	nS
Delay Time 1				250	nS
Delay Time 1				100	nS

**BLOCK DIAGRAM**



**FIG.1 BLOCK DIAGRAM**

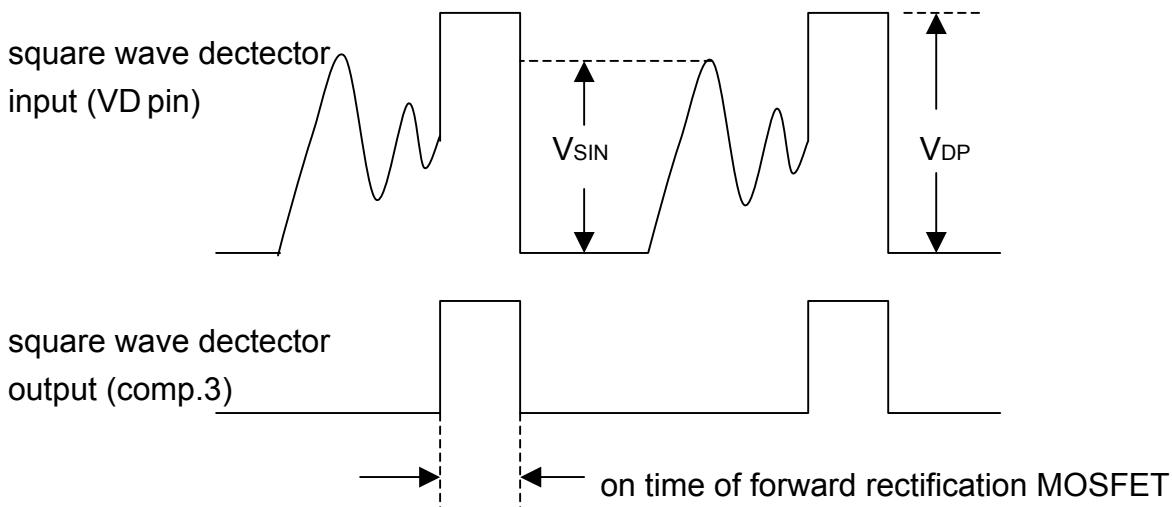
**OPERATION DESCRIPTION .**

**•Under Voltage Lockout ( UVLO )**

The UVLO function ensures the supply voltage Vcc is adequate to fully operating before enabling the output driver stage. The supply voltage Vcc must reached 7V level and the output drivers just can be enable to prevent the device into unstable condition.

**•Synchronization**

The N3858 synchronization is obtained directly from the secondary side using the voltage across the fly-wheeling synchronous rectification MOSFET as the information for the switching transitions. Refer to FIG.2 , a square wave detector filters the eventual sinusoidal waveform caused by discontinuous mode operation to prevent a wrong driving of the forward rectification MOSFET by a wrong synchronization .



**FIG. 2 DCM waveform**

$$\frac{V_{SIN} R2}{R1+R2} < 5V \quad ; \quad \frac{V_{DP} R2}{R1+R2} > 5V$$

A proper setting R1 and R2 to make sure  $V_{SIN} R2 / (R1+R2) < 5V$  ,  $V_{DP} R2 / (R1+R2) > 5V$  to get a good driving of the forward rectification MOSFET .

**•Inhibit Function**

The inhibit function is detected VD voltage if  $VD > 0V$  the GATE2 output will be disable to turn off the fly-wheeling synchronous rectification MOSFET Q2 when the current through it tends to reverse, allowing discontinuous mode condition and providing protection to the device from eventual sinking current from the output tank.

**•Constant Dead Time Control**

The RCD pin is connected a  $R_T$  and  $C_T$  to adjust a optimal dead time to prevent the fly-wheeling synchronous rectification MOSFET and the forward rectification MOSFET working on-state condition when during fly-wheeling period is ended. If  $R_T$  and  $C_T$  fixed, however AC input or duty cycle is changing , then the dead time will be fixed to be constant.

In this structure, to select small tolerance(1~2%) of some componets will be necessary, such as  $R_T/C_T$  of N3858 ,and the frequency componets  $R_t / C_t$  of the PWM controller . Otherwise , it may cause Q1and Q2 turn-on at same time.

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

**Dead time(max) =  $T_s \times \text{Total Tol.}\% + t_{d(\text{off})}$  of S.R. MOSFET** ,  $T_s = 1/f_s$   
**Dead time(min) =  $t_{d(\text{off})}$  of S.R. MOSFET** , **Total Tol.%= $(R_t + C_t)$  Tol.%**

**• Enable / Disable Function**

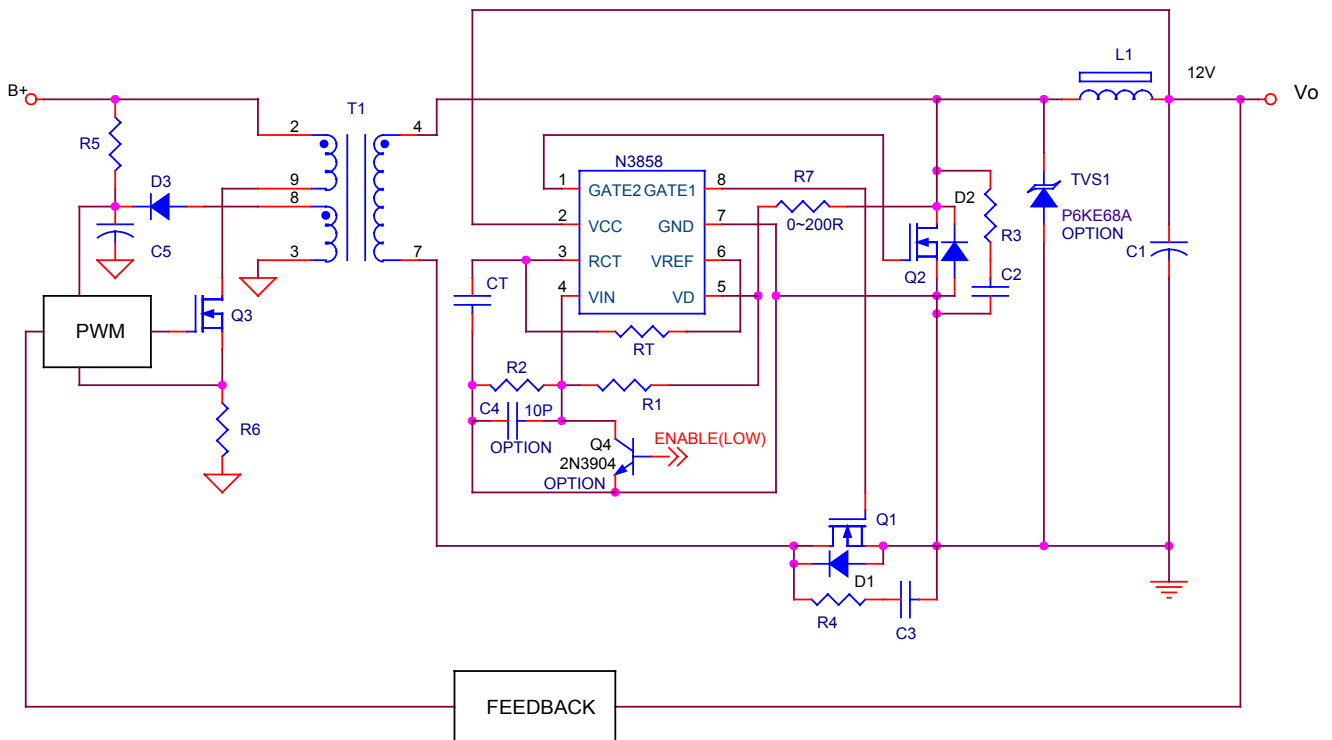
The VIN pin is able to provide the enable/disable function to control the outputs of GATE1 and GATE2 , if connect VIN to GND , the outputs of GATE1 and GATE2 stopped to output .

**•Gate Output**

The N3858 output stages build two of totem pole drivers for driving the forward rectification and fly-wheeling synchronous rectification MOSFET. Each driver is capable of source and sink 1A current output . The GATE1 pin is designed for driving the forward rectification MOSFET and GATE2 pin is designed for driving the fly-wheeling synchronous rectification MOSFET .

**TYPICAL APPLICATION CIRCUIT**

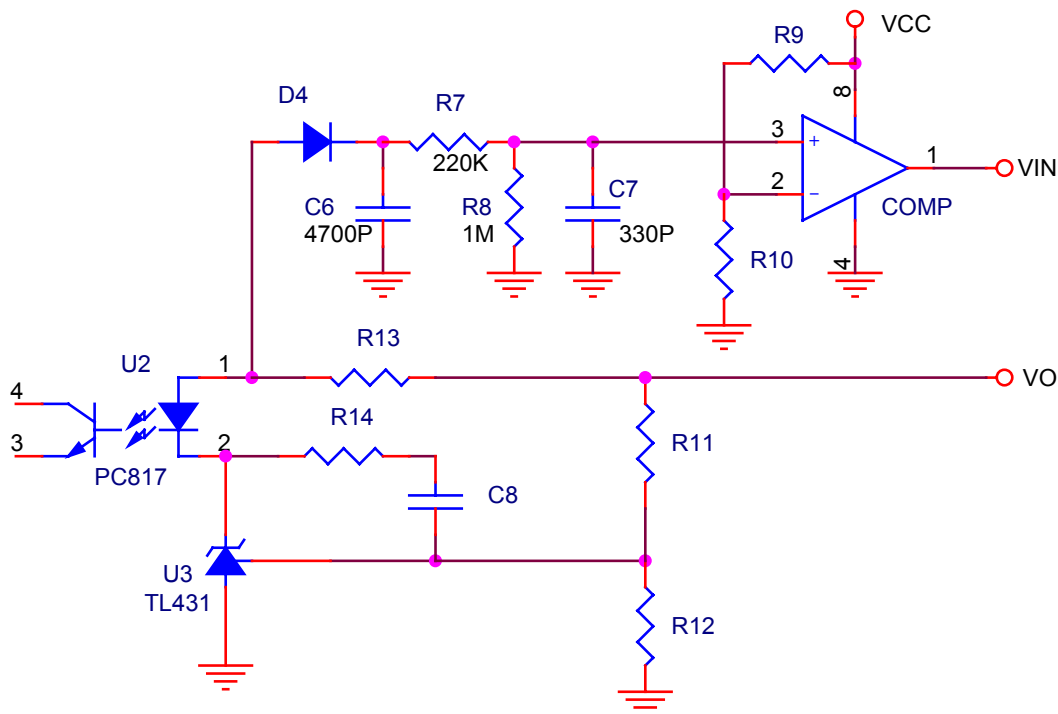
See the FIG.3 , the circuit is the typical application of the N3858 , The TVS1 is connected between drain and source of the fly-wheeling synchronous rectification MOSFET Q2 to reduce the spike voltage between drain and source . The C4 capacitor is connected a small capacitance to reduce the noise and prevent a wrong action .



**FIG.3 TYPICAL APPLICATION CIRCUIT**

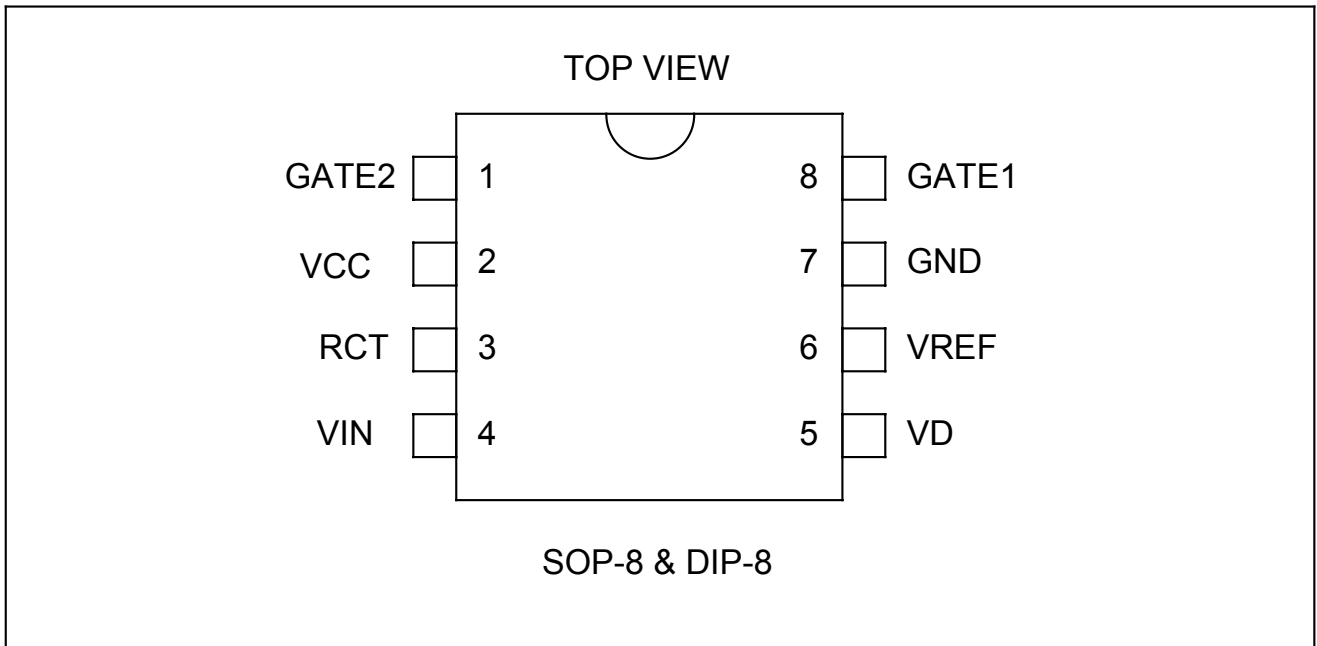
**How to disable the outputs in DCM condition**

See the FIG.4 ,the circuit provided the disable function to control the outputs of GATE1 and GATE2 , when during DCM condition , the outputs of GATE1 and GATE2 is stopped low level to reduce the power loss . when power device come to light load or DCM condition , the pin1 voltage of photo-coupler (U2) is changed to lower level than middle load or CCM condition, the voltage flow through R and C filter to input pin (+) of the comparator and compare to the reference voltage that devided from R9 and R10 .



**FIG.4 DISABLE APPLICATION CIRCUIT IN DCM CONDITION**

**PIN CONFIGURATIONS**



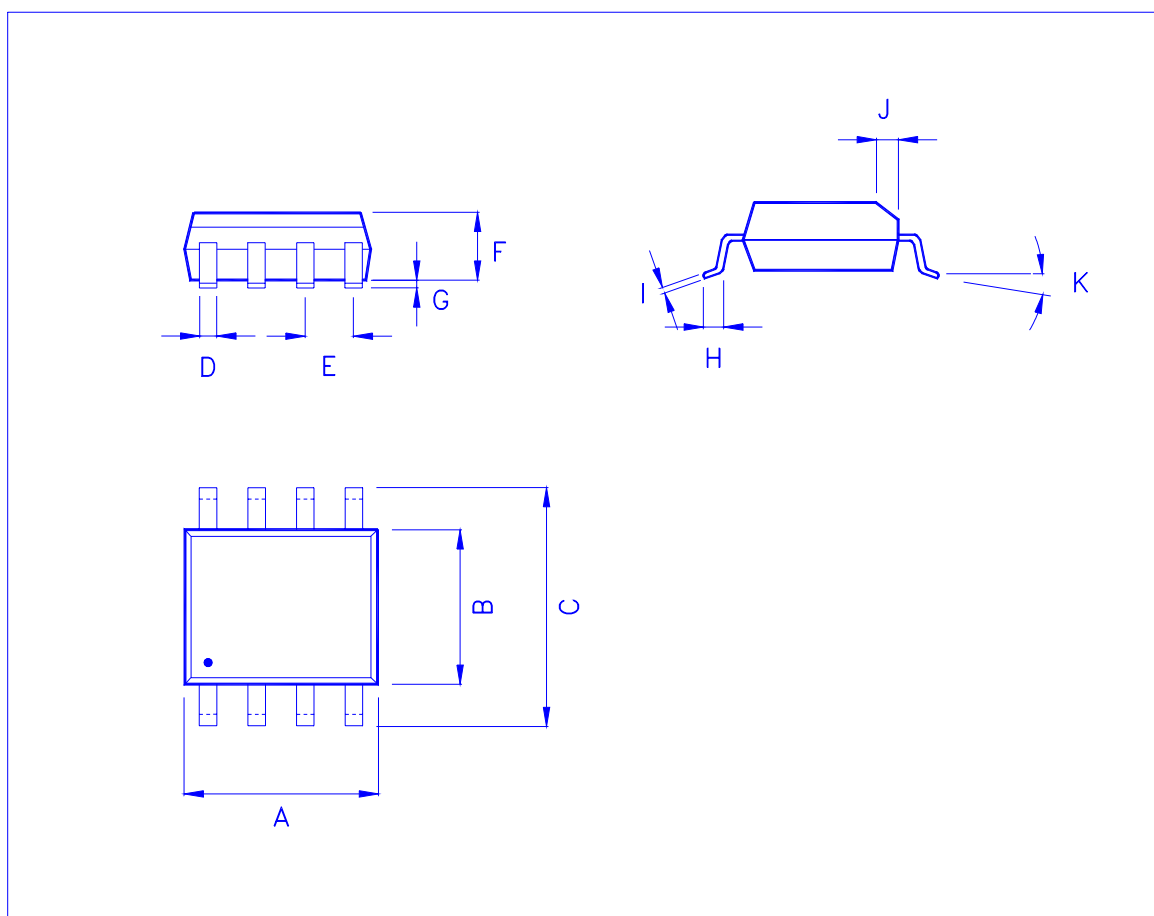
**FIG.5**

**PIN FUNCTIONS**

NO.	FUNCTION	DESCRIPTION
1	GATE2	This pin is the output pin to drive the gate of the synchronous recitification MOSFET.
2	VCC	This pin is for supply voltage of the control IC.
3	RCD	This pin connect Rt and CT to generate a constant sawtooth waveform .
4	VIN	Input pin (+) of the Comparator 3., connected R1and R2 to filter sinusoidal waveform voltage during the DCM condition.
5	VD	Input pin(-) of comparator 1 , inhibit function detect pin , connected to the Drain pin of the fly-wheeling synchronous recitification MOSFET.
6	VREF	5V reference voltage output, it provides charging current for CT through RT .
7	GND	GND pin ,connected to the Source pin of the fly-wheeling synchronous recitification MOSFET.
8	GATE1	This pin is the output pin to drive the gate of the forward recitification MOSFET.

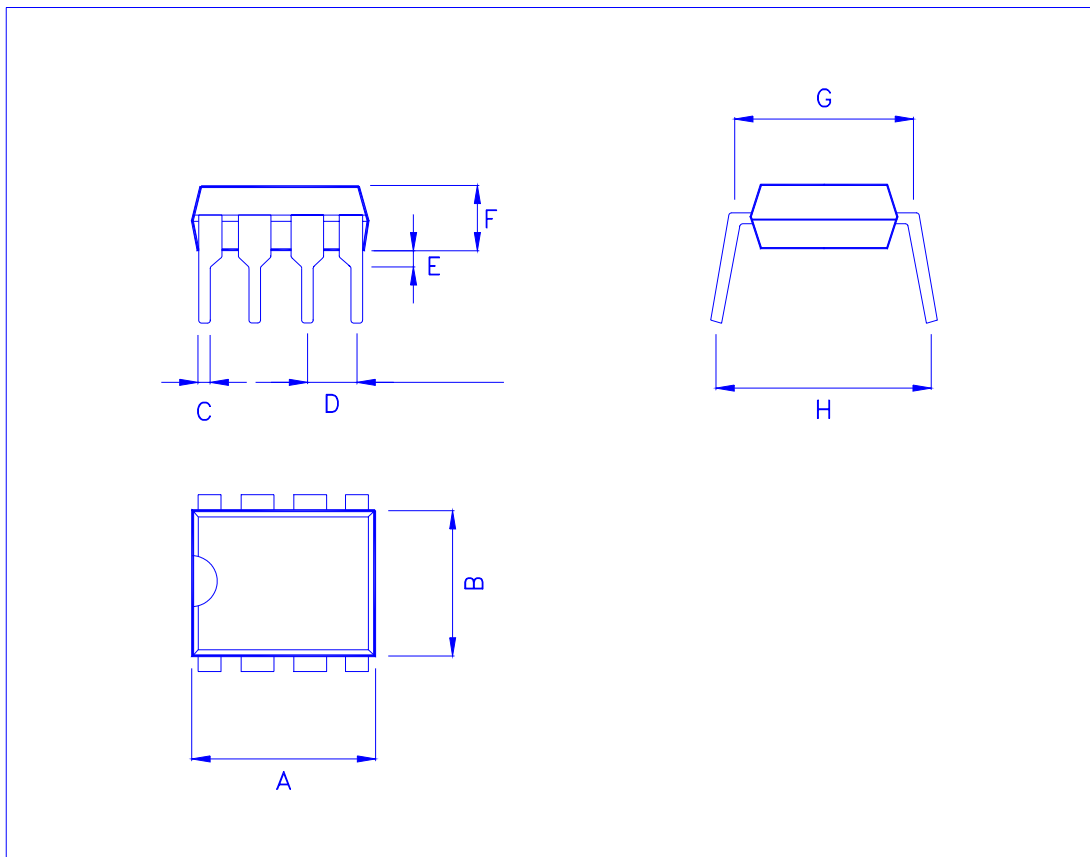
**SOIC-8 (D) MECHANICAL DATA**

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			



**DIP-8 MECHANICAL DATA**

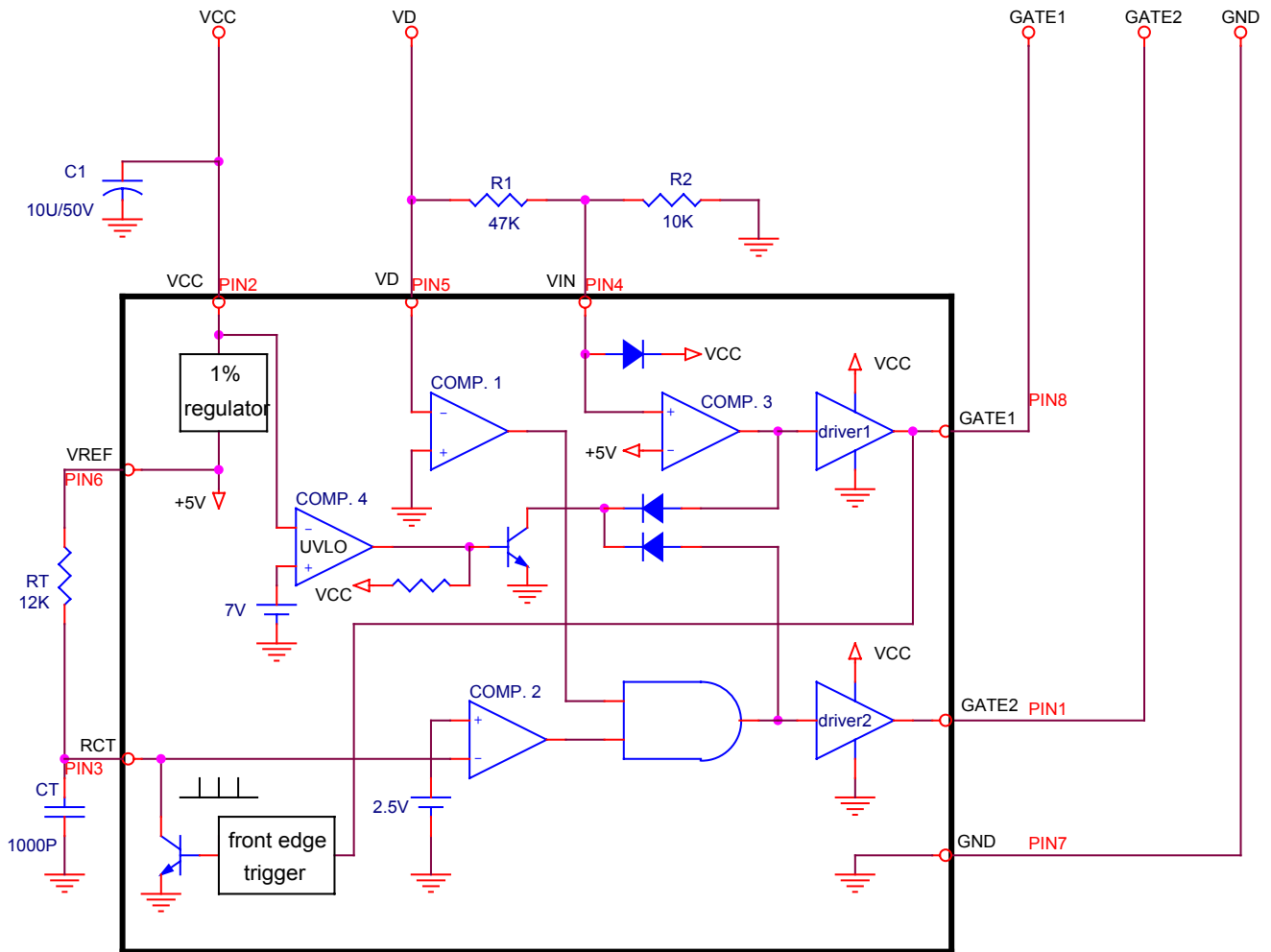
Dimension	mm			Dimension	mm		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	8.8		9.6	H	7.95		9.75
B	6.2		7.0	I			
C	0.35	0.45	0.55	J			
D		2.54		K			
E	0.5		0.8	L			
F	3.05	3.28	3.56	M			
G	7.48	7.62	8.13	N			





**DEMO BOARD DESCRIPTION**

The FIG.6 presents a demo board for the N3858V , This board replaces the output rectifier diode and fly-wheeling diode with power MOSFETs in forward power supply and includes all the components needs by the N3858V to operate, RTand CT can be adjusted for different switching frequency and dead time demand .



**FIG.6 DEMO BOARD SCHEMATIC**