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1. General Description

The MG39U301 is a current feedback control, buck type LED driver IC. It achieves good output current regulation without the need of external compensation components. The switching control scheme can be programmed to either `constant frequency` or `constant off time` mode with the configuration of external switching setting resistor.

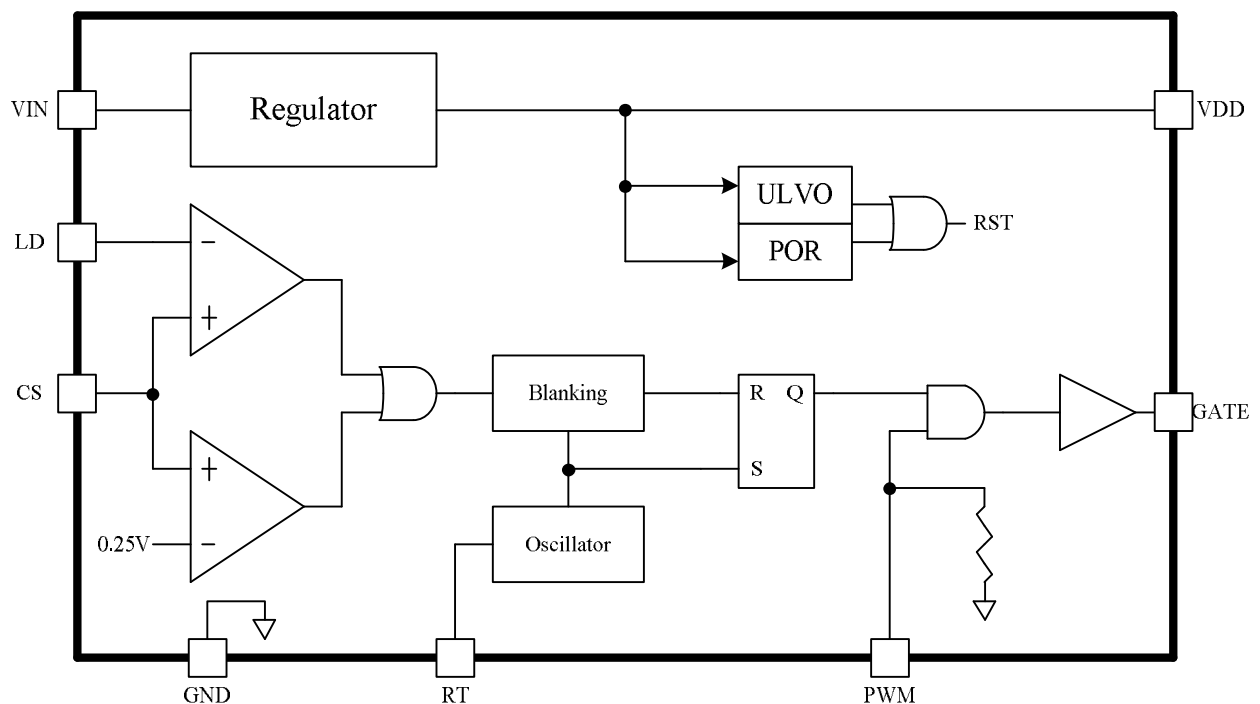
The MG39U301 integrates a HV start-up circuit, 6~450V linear regulator, precision comparator, PWM control and ring oscillator into one chip. With those building circuits, a precision current output, buck mode converter can be easily achieved with only few external components. The chip also provides both liner and PWM dimming function. The linear dimming control input is 0~0.27V (at LD pin) & the PWM dimming range is 0~100% duty at a frequency of up to 10Khz.

The chip is available in 8 lead or 16 lead SOP package.

2. Features

- ┆ Operation voltage, 6v ~ 450v
- ┆ Provide constant frequency or constant off time control
- ┆ Open loop current peak detector
- ┆ Linear or PWM dimming control

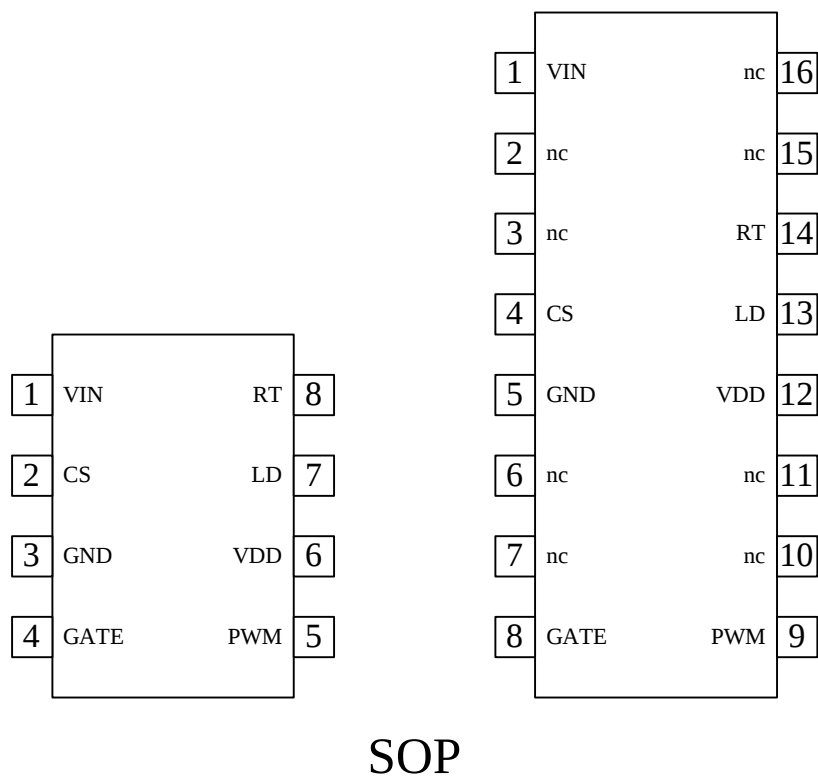
3. Block Diagram



4. Applications

- | DC-DC or AC-DC LED driver application
- | Backlighting LED driver
- | General purpose constant current source

5. Pin Configurations



6. Pin Descriptions

SOP-8	SOP-16	Pin Name	Description
1	1	VIN	6~450V high voltage input
2	4	CS	Current sense input pin
3	5	GND	Ground pin
4	8	GATE	Driver for external power MOS
5	9	PWM	PWM dimming input
6	12	VDD	Regulated core supply
7	13	LD	Linear dimming input. If current sense threshold is required less than 0.27V, an external voltage can be applied to this pin.
8	14	RT	Ring oscillator bias input. When RT is connected o ground via a resistor, the MG39U301 operates in constant frequency mode. When the resistor is connected between RT & GATE, the MA1xx operates in constant off-time mode.
~	~	nc	No connection

7. Absolute Maximum Rating

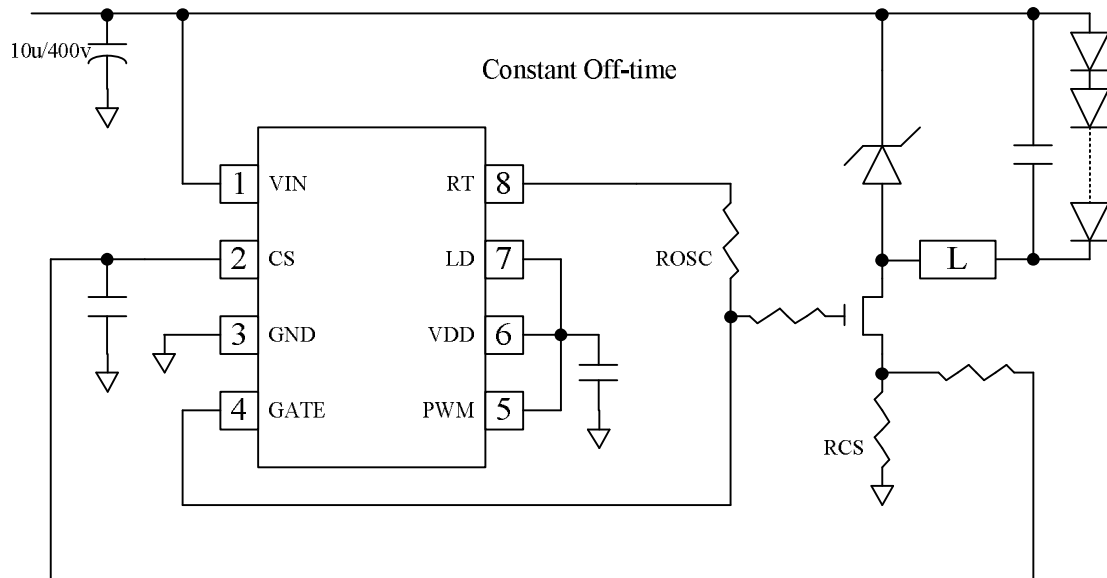
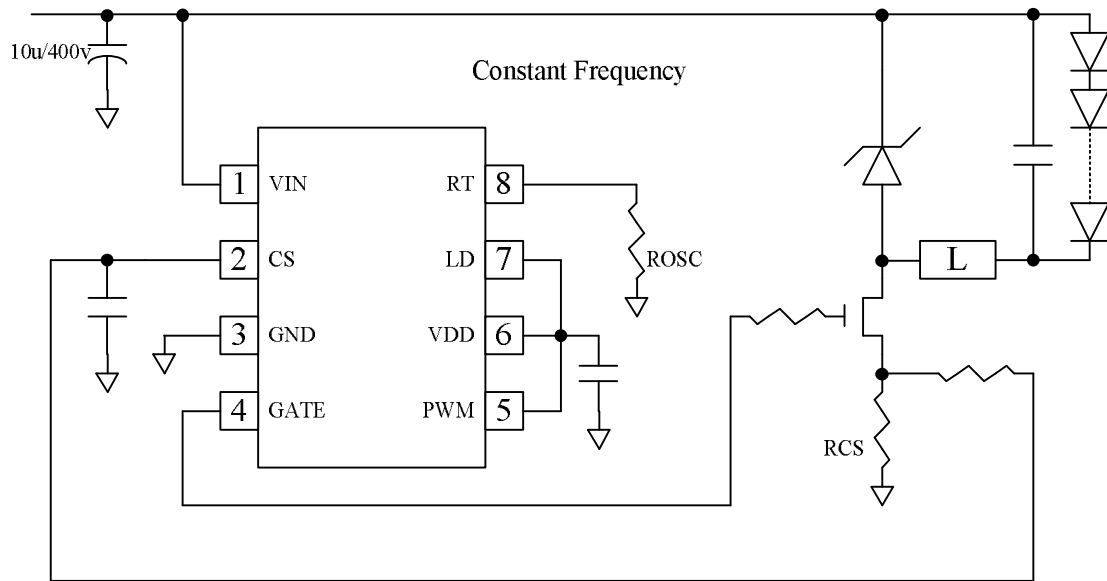
Parameter	Value
Supply Voltage	-0.5v ~ 470v
Operating temperature	-40 ~ 125 degree
Storage temperature	-55 ~ 155 degree

8. Electrical Characteristics

All typical numbers are at Ta=25 & VIN=12V, unless otherwise noted.

Symbol	Parameter	Min.,	Ty p.	Max	Unit	Conditions
V _{INDC}	Input DC supply voltage range	6		450	V	DC input voltage
I _{INSD}	Shut-Down mode supply current		0.5	0.8	mA	Pin PWM_D to GND, V _{IN} =6V
IOP	Operating Current		0.8	1.2	mA	V _{IN} > 7V, RT=226K & CGATE=500P
Internal Regulator						
V _{DD}	Internally regulated voltage	5	5.6	6	V	V _{IN} =6V~450V, RT=226K, Cgate=500p, VDD no external load.
V _{DD_ext}	Maximal pin V _{DD} voltage			7	V	When an external voltage applied to pin V _{DD}
I _{source}	Output current of the regulator		1		mA	V _{IN} > 7V
UVLO	V _{DD} undervoltage lockout threshold		5.3		V	VDD=5.5V
ΔUVLO	V _{DD} under-voltage lockout hysteresis	100	300	500	mV	V _{IN} falling
PWM Dimming						
V _{EN(hi)}	Pin PWM_D input high voltage	2.0			V	V _{IN} =6V~450V
V _{EN(low)}	Pin PWM_D input low voltage			0.8	V	V _{IN} =6V~450V
R _{EN}	Pin PWM_D pull-down resistance	50	100	150	kΩ	VDD = 5.5V.
PwmD	PWM signal duty	0		100	%	
Current Sense Input						
V _{CSth}	Current sense pull-in threshold voltage	255	275	285	mV	@TA = 0°C to +125°C, VDD=5.5
		200			mV	@TA = -40°C
V _{OS}	Offset voltage of Comparator	-20		20	mV	
T _{BLANK}	Current sense blanking interval	150	215	285	ns	V _{CS} =0.55V _{LD} , V _{LD} =V _{DD}
T _{DELAY}	Delay from CS trip to GATE IO			300	ns	V _{LD} =VDD, V _{CS} = V _{CSth} + 50mv after T _{BLANK}
V _{LD}	Linear Dimming pin Voltage range	0		V _{CSth}	mV	
Gate Driver						
V _{GATE(hi)}	GATE high output voltage	V _{DD} -0.4			V	
V _{GATE(low)}	GATE low output voltage			0.4	V	
T _{RISE}	GATE output rise time		30	50	ns	C _{GATE} =500pF
T _{FALL}	GATE output fall time		30	50	ns	C _{GATE} =500pF
I _{oh}	GATE output high driving current		10		mA	VGATE = VDD – 0.4
I _{ol}	GATE output low sinking current		25		mA	VGATE = 0.4
Oscillator						
F _{OSC}	Oscillator frequency	22	27	32	kHz	R _{OSC} =1.00MΩ
		90	110	120	kHz	R _{OSC} =226KΩ

9. Typical Application Circuit



10. Application Information

Input Voltage Regulator

The MG39U301 integrates one high voltage regulator to generate the power for internal core logic. The internal power is taken from the AC line directly. Extra auxiliary transformer is not needed for the supply. When a voltage (6~500V) is applied at the VIN pin, the regulator maintains a constant 5.6V at the VDD pin. The VDD pin must be bypassed by a low ESR capacitor to provide a low impedance path for the high frequency current of the output date driver.

Since the current driving capability of the regulator is limited to around 1mA. It's not suitable for driving the external components. User must make sure the switching frequency should not be too high & the load at the GATE pin should not be too heavy.

It's recommended to add a series resistor between V_{AC} and V_{IN} pin to protect the IC. Basically, several ten K to 100K ohms is recommended. The voltage drop on the resistor can be calculated as $V_{R_{DROP}} = I_{OP} \times R_{series}$.

Selection of the Switching Control Scheme

The MG39U301 provides two control schemes, constant frequency & constant off time. For a buck converter, the duty of PWM control signal is determined as $D = V_o / V_{IN}$, where V_o is the voltage drop on LED strings. For a heavy load application (large V_{LED} drop, D>0.45), user should select the constant off time mode.

Selection of the Switching Frequency

Rule of thumb, the range of 20Khz ~ 100Khz is recommended.

For detail frequency setting, please check application note `MG39U301 – ROSC selection`.

Selection of the Sense Resistor (R_{CS})

The MG39U301 is an open loop buck converter with peak current control. The peak current is decided by the equation $I_{PEAK+} = V_{CS_{TH}} / R_{CS}$, where V_{CS_{TH}} is around 0.27V. The average current (I_{LED}) is described as follow:

The ΔI_{LED} is determined by T_{OFF}, L value and V_{LED} load.

