

Description

U2281 is highly integrated current mode PWM control IC for flyback convertor. The maximum output power is up to 60W. U2281 can meet level 6 energy-efficiency standard and EMC requirement easily.

U2281 has comprehensive protection feature to ensure the reliability of system. The packaging form of U2281 has SOT23-6、SOP8 and DIP8.

Features

- ⌘ Digit frequency shuffling technology to improve EMI performance.
- ⌘ Fixed 65kHz PWM switching frequency.
- ⌘ Leading-edge blanking on current sense.
- ⌘ Internal synchronized slope compensation.
- ⌘ Low standby power consumption (<75mW@AC 230V)
- ⌘ Soft-start to reduce MOSFET Vds stress during power on

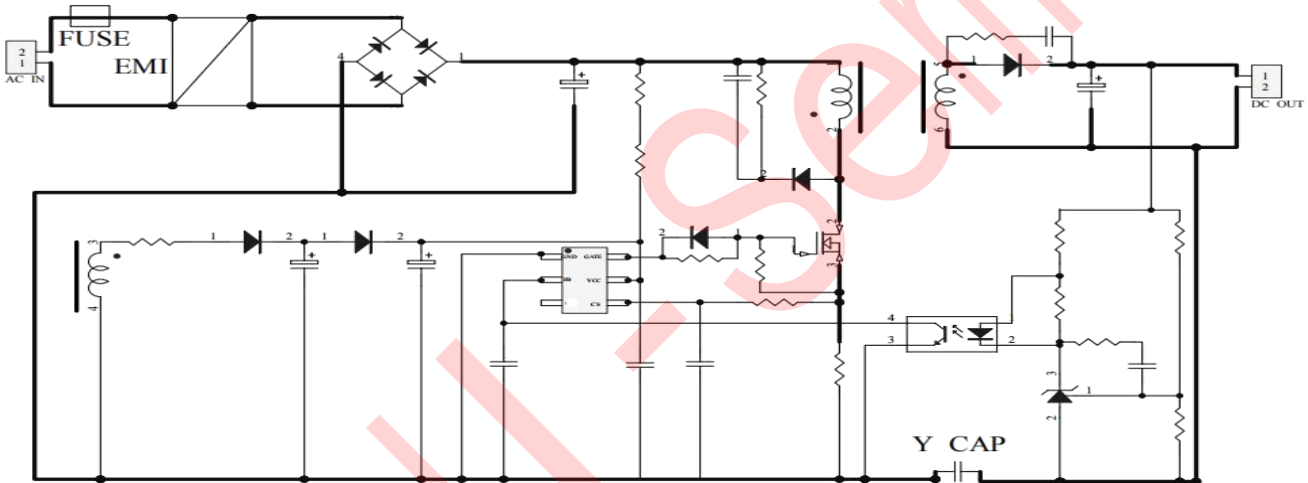
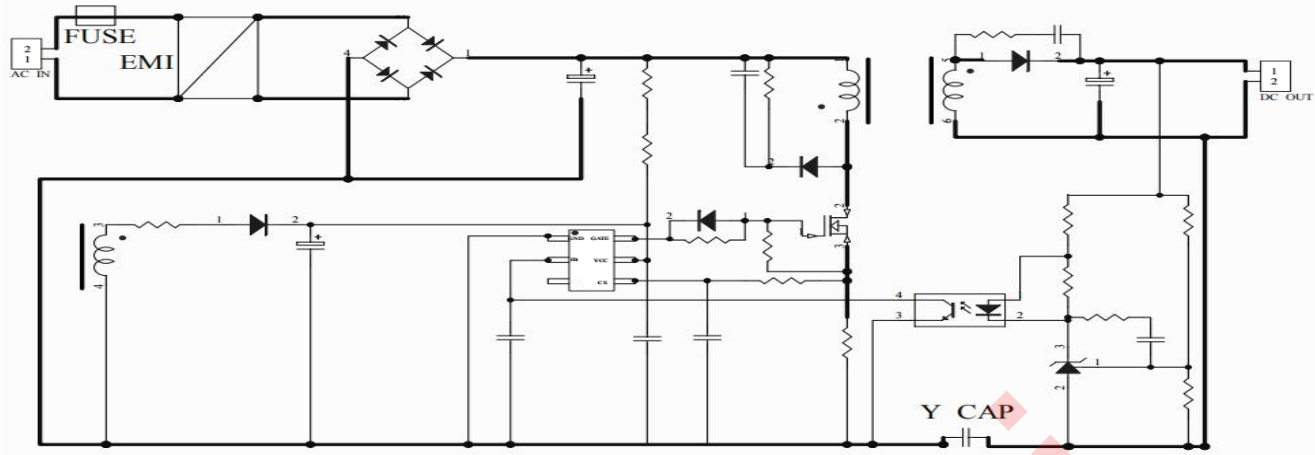
- ⌘ Comprehensive protection function
 - 1、 Under voltage locked with hysteresis (UVLO) on VDD.
 - 2、 Over voltage protection (OVP) on VDD.
 - 3、 Cycle-by-Cycle current limitation.
 - 4、 Over load protection (OLP)
 - 5、 Over temperature protection (OTP)
 - 6、 Current limitation compensation to obtain the same output current in universal ac line input
- ⌘ Low start-up current (<10uA@VDD=12V)
- ⌘ 300mA of sinking and 150mA of sourcing current capability in GATE pin

Applications

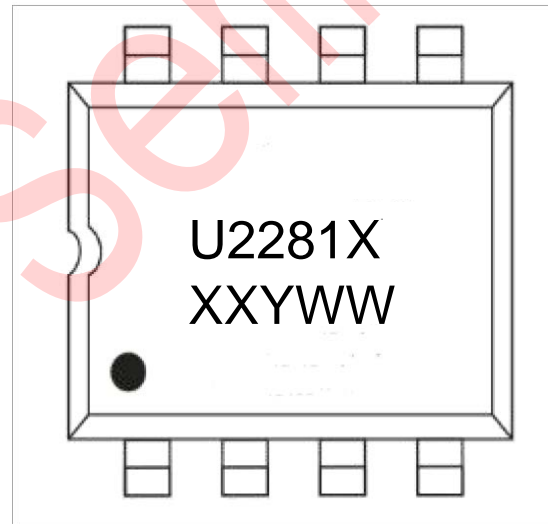
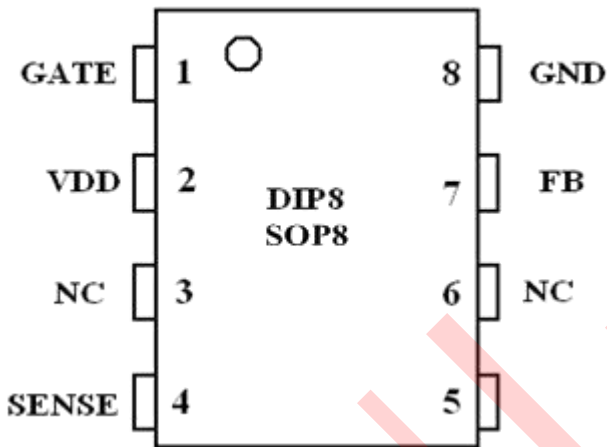
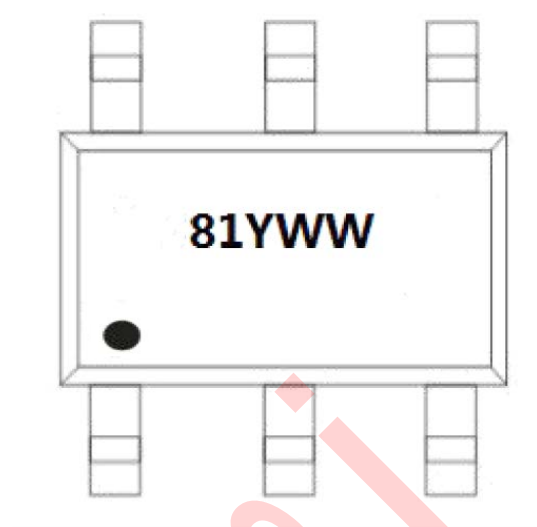
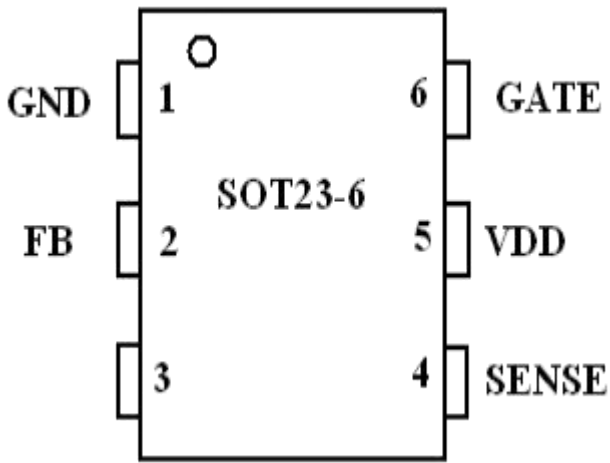
- ⌘ Cell Phone Charger
- ⌘ Digital Cameras Charger
- ⌘ Battery charger

Application Circuit

Two large value resistors are connected to VCC capacitor in startup circuit.



Pin Assignment & Marking Information



XX: Internal Identifier
Y: Year code (2019=C)
WW: Week code (01-52)

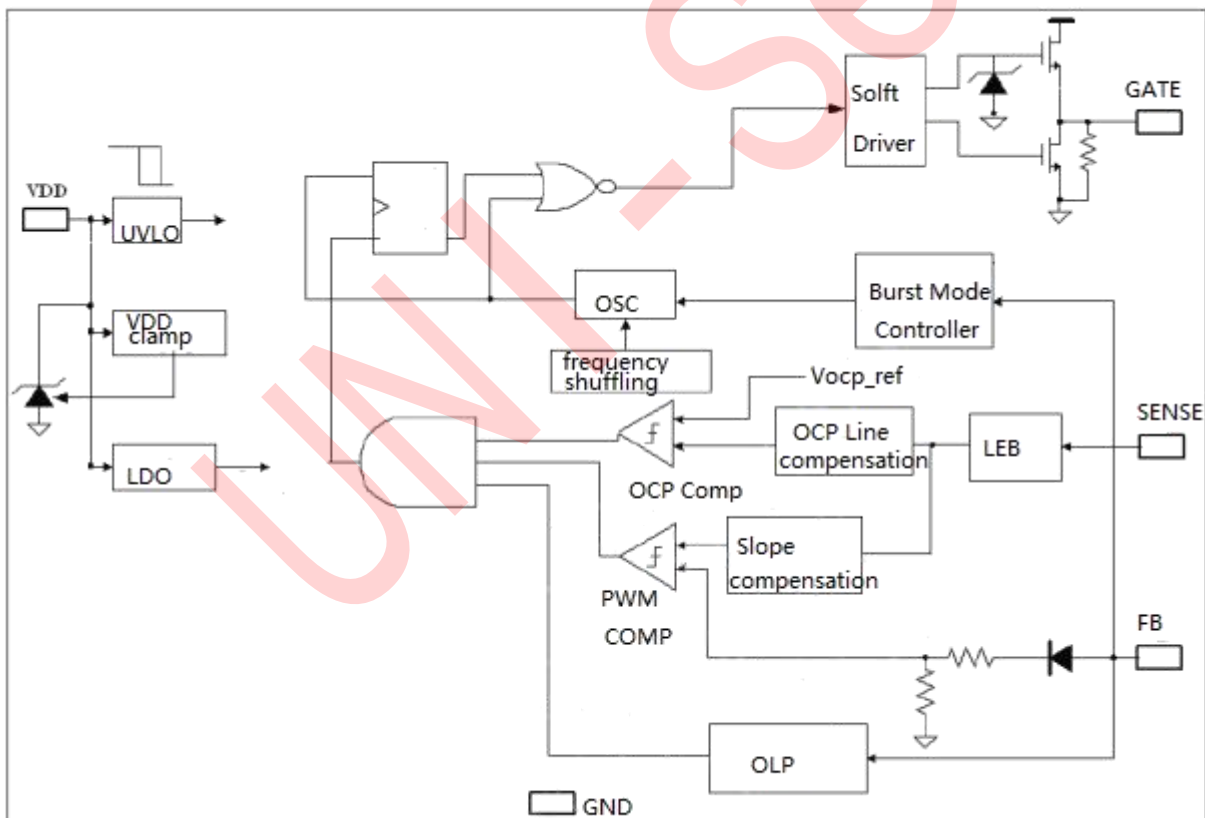
Ordering Information

Part number	Package	version number
U2281T	SOT23-6	
U2281S	SOP-8	
U2281D	DIP-8	

Pin Description

Symbol	Type	Description
GATE	O	Totem-pole gate driver output for the power MOSFET
VDD	P	Chip DC power supply pin
SENSE	I	Current sense input pin.
FB	I	Feedback input pin.
Gnd	P	Ground.

Block Diagram



Absolute Maximum Rating

Parameter	Value	Unit
VDD clamp voltage	29	V
VDD clamp current	10	mA
VFB input voltage	-0.3 to 7	V
VSENSE input voltage to SENSE pin	-0.3 to 7	V
Min/Max operating junction temperature	-55 to 150	°C
Operating ambient temperature	-20 to 85	°C
Thermal resistance, Junction to ambient SOT23-6	250	°C/W

Note: Stresses above absolute maximum ratings may cause permanent damage to the device. Exposure to absolutely maximum-rated conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Symbol	Parameter	Min. Max.	Unit
VDD	Supply Voltage Vcc	9 to 25.5	V
Toa	Operating Ambient temperature	-20 to 85	°C
ESD-HM	Human Model	2	KV
ESD-MM	Machine Model	150	V

Electrical Characteristics (T_A = 25 °C, if not otherwise noted)

Symbol	Parameter	Conditions	Value			Unit
			Min	Typ	Max	
Supply Voltage (V_{DD} Pin)						
I _{DD_start-up}	VDD start-up current	VDD=12.5V		3	10	uA
I _{DD}	VDD Operation current	VDD=16V FB=2V		1.5		mA
UVLO(ON)	VDD under voltage lockout enter		6.8	7.8	8.2	V
UVLO(OFF)	VDD under voltage lockout exit		13	13.4	16.5	V
OVP	VDD over voltage protection		25.5	26.5	28	V
Voltage Feedback (FB Pin)						
AVCS	PWM input gain	VFB/VSENSE		2		V/V
VFB_open	VFB open loop voltage			5.7		V
IFB_short	FB pin short current	Short FB pin to GND	90	150	300	uA
VFB_burst	Burst mode voltage			1.1		V
VTH_PL	Power limiting FB threshold voltage			3.7		V

TD_PL	Power limiting delay time			60		mS
DC_MAX	Maximum duty cycl	VDD=18V, SENSE=0V FB=2.2V		75		%

Current Sensing (SENSE Pin)						
T_blanking	Leading-edge blanking time		100	400	750	nS
ZSENSE_IN	Input impedance			40		K Ω
VTH_sense	Over current threshold voltage	Duty=0%	0.51	0.56	0.61	V
Oscillator						
Fosc	Normal oscillation frequency		60	66.5	73	KHz
Δ f_temp	Frequency temperature stability	TA= -20°C to 100°C		5		%
f_VDD	Frequency voltage stability	VDD=16.5V to 25V		5		%
Fosc_BM	Burst mode base frequency		17	25	28	KHz
Δ f_0SC	Frequency modulation range Base frequency		-5		+5	%
Gate Drive Output						
VOL	Output low level	VDD=16V, IO=-20mA			0.8	V
VOH	Output high level	VDD=16V, IO=20mA	10			V
V_Clamp	output clamp voltage level			12		V
T_r	Output rising time	VDD=16V, CL=1nF		1300		nS
T_f	Output falling time	VDD=16V, CL=1nF		50		nS

Application Information

U2281 is a highly integrated PWM control IC for the flyback converter. U2281 is designed specifically for switching power supply that requires level 6 energy-efficiency. The input power is less than 75mW at No-load condition in universal input voltage rang.

Start up Control

U2281 has very low start-up current that is less than 10uA. Therefore, a large resistor can be used in start-up circuit of switch power supply. This will minimize standby dissipation. The typical resistance of start-up resistor is 4M ohms.

Operating Current

The Operating current of U2281 is less than 1.5mA. Therefore, U2281 can have good efficiency.

Frequency shuffling for EMI improvement

The frequency Shuffling is implemented in U2281. The oscillation frequency is modulated with a random source so that the harmonic energy is spread out. The spread spectrum minimizes the conduction EMI and therefore reduces system design challenge.

Burst Mode Operation

At zero load or light load condition, the main power dissipation in a switching mode power supply is from switching on the MOSFET, the core of transformer and the snubber circuit. The magnitude of power dissipation is proportional to the number of switching frequency within certain period. Less switching frequency can reduce the power dissipation. U2281 adjusts the switching frequency according to the loading condition. The PWM pulse width is kept greater than 1.2uS at any load condition. From light load to no load, the FB voltage drops. While the FB voltage is less than 1.1V, the gate pin output is disabled and kept low, while the FB voltage is higher than 1.2V, the gate output recovers to normal working mode. This is called 'burst mode'. To reduce audio noise, the switching frequency will be kept higher than 20KHz in burst mode.

Oscillator Operation

The switching frequency is internally fixed at 65kHz. No external frequency setting components are required on PCB design.

Current Sensing and Leading-Edge Blanking

Cycle-by-Cycle current limitation is offered in U2281. The switching current is detected by a resistor into the SENSE pin. An internal leading-edge blanking circuit chops off the SENSE voltage spike at initial so that the external RC filtering on SENSE pin is no longer required. The current limiting comparator is disabled and thus cannot turn off the external MOSFET during the blanking period. PWM duty cycle is determined by the voltage in the SENSE pin and the FB pin.

Internal Synchronized Slope Compensation

Slope compensation circuit adds voltage ramp onto the SENSE voltage according to PWM pulse width. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage. Slope compensation can help U2281 obtain the same output current in universal ac input voltage.

Gate Drive

The GATE pin of U2281 has 300mA of sinking and 150mA of sourcing current capability. Therefore, the MOSFET would be turned on slowly and turned off fast so that U2281 has high efficiency and low radiation EMI. The highest voltage of drive voltage is clamped at 12V.

Protection Controls

U2281 has comprehensive protection functions, including Cycle-by- Cycle current limitation (OCP), Over Load Protection (OLP) and over voltage clamp, Under Voltage Lockout on VDD (UVLO), Over Temperature Protection (OTP).

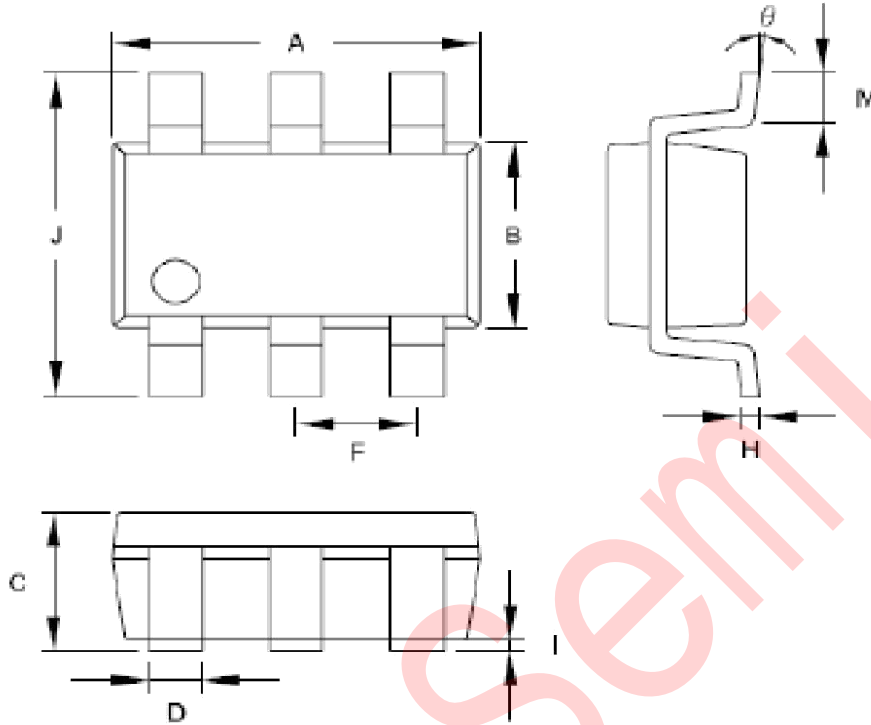
Current limitation compensation

To obtain the same output current capability, the OLP threshold voltage is compensated for the different input AC voltage. This function makes the current of OLP is in consistency whatever the AC input is (110V or 220V).

UNI - Semi

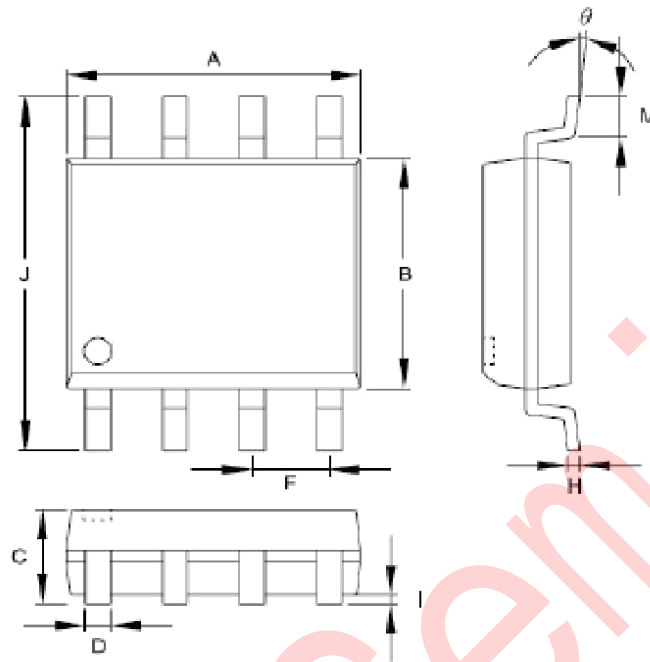
Package Information

SOT-23-6



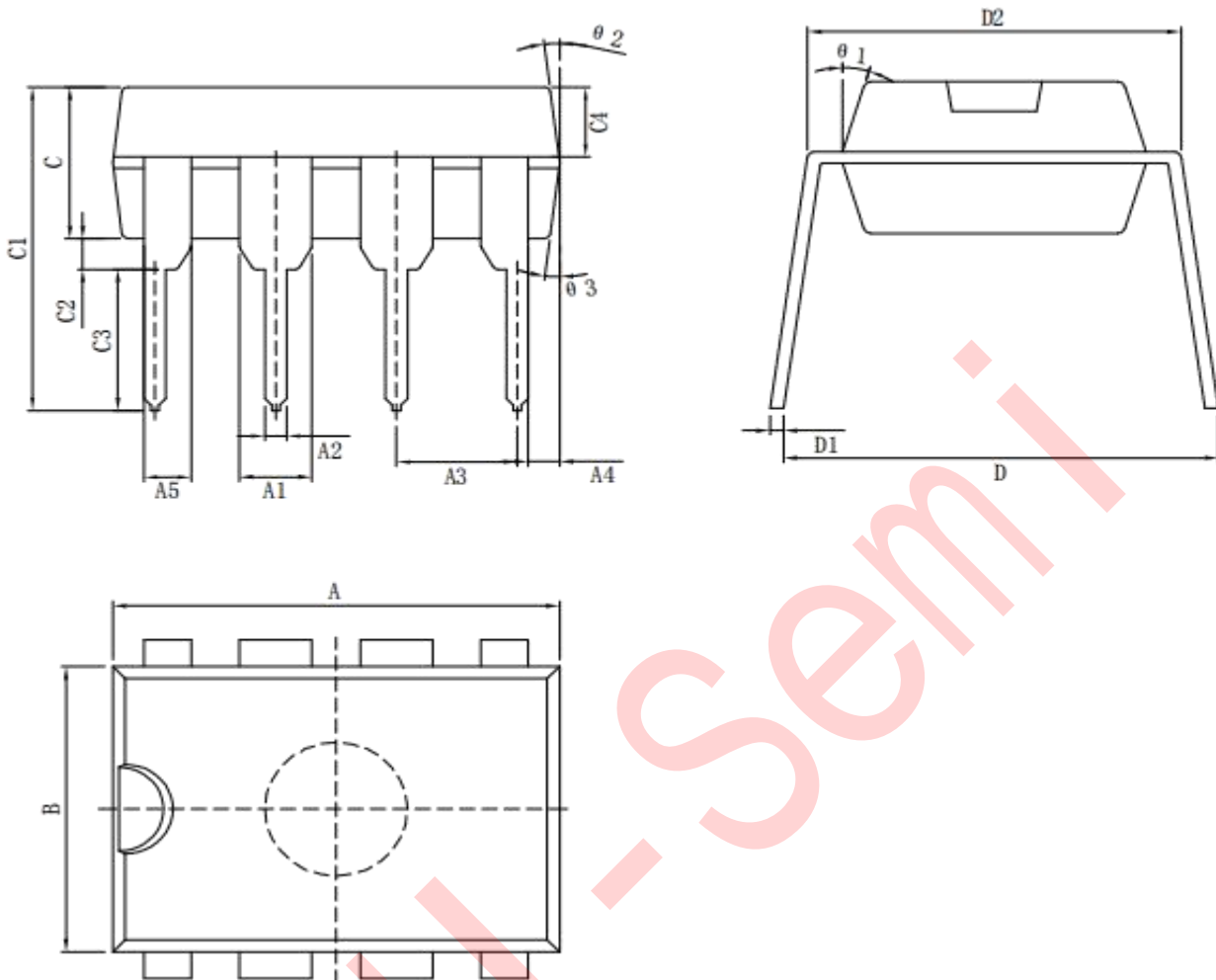
Symbol	Dimension in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	2.692	3.099	0.106	0.122
B	1.397	1.803	0.055	0.071
C	-----	1.450	-----	0.058
D	0.300	0.550	0.012	0.022
F	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
I	0.050	0.150	0.002	0.006
J	2.600	3.000	0.102	0.118
M	0.300	0.600	0.012	0.024
θ	0°	10°	0°	10°

SOP-8



Symbols	Dimensions in Millimeters		Dimensions in Inch	
	MIN	MAX	MIN	MAX
A	4.801	5.004	0.189	0.197
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.178	0.229	0.007	0.009
I	0.102	0.254	0.004	0.010
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050
θ	0°	8°	0°	8°

DIP-8



Symbol	Size	MIN (mm)	MAX (mm)	Symbol	Size	MIN (mm)	MAX (mm)
A		9.00	9.20	C2		0.50TYP	
A1		1.474	1.574	C3		3.20	3.40
A2		0.41	0.51	C4		1.47	1.57
A3		2.44	2.64	D		8.20	8.80
A4		0.51TYP		D1		0.244	0.264
A5		0.99TYP		D2		7.62	7.87
B		6.10	6.30	theta 1		17° TYP4	
C		3.20	3.40	theta 2		10° TYP4	
C1		7.10	7.30	theta 3		8° TYP	

Revision History

Version	Update date	Version By	Revised content
V1.1	2017-7-14	Li Wen	Preliminary
V1.2	2019-7-14	Li Wen	OCP,OVP,LEB

UNI-Semi