Green Mode PWM Controller

General description

The AP8267 is a highly integrated current mode PWM control IC for high performance, low standby power and cost effective offline flyback converter applications.

AP8267 operates in green mode. According to load condition, it can reduce frequency to minimize switching loss. Lower standby power and higher conversion efficiency is thus achieved.

AP8267 offers complete protections coverage with automatic self-recovery feature including Cycle-by-Cycle current limiting (OCP), VDD over voltage protection, output over voltage protection (OVP), over temperature protection (OTP), over load protection (OLP), output diode short protection, soft-start and Burst mode operation.

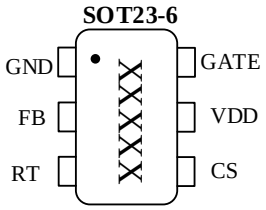
Application

- DVB Power Supplies
- Power Adapter
- Open-frame SMPS

Features

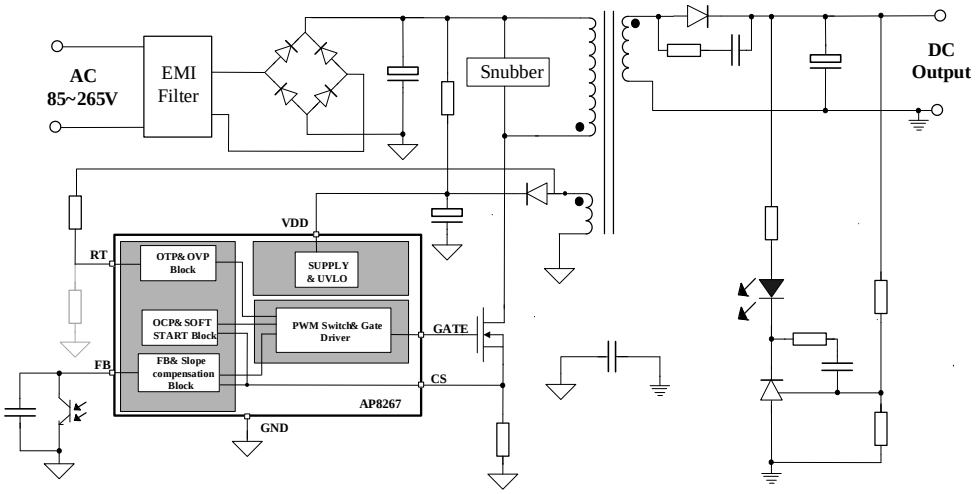
- Proprietary Frequency Jitter for EMI
- Green Mode Control
- Audio Noise Free
- Internal Slope Compensation
- Line Input Compensation
- Soft start-up function
- Good Protection Coverage With Auto Self- Recovery
  - ✧ Cycle-by-Cycle Over-current Threshold Setting (OCP)
  - ✧ Over Load Protection (OLP)
  - ✧ VDD Over Voltage Protection (OVP)
  - ✧ Output Over Voltage Protection
  - ✧ Output Diode Short Protection
  - ✧ Over Temperature Protection (OTP)

Package/Order Information



Order code	Package
AP8267TCC-R2	SOT23-6

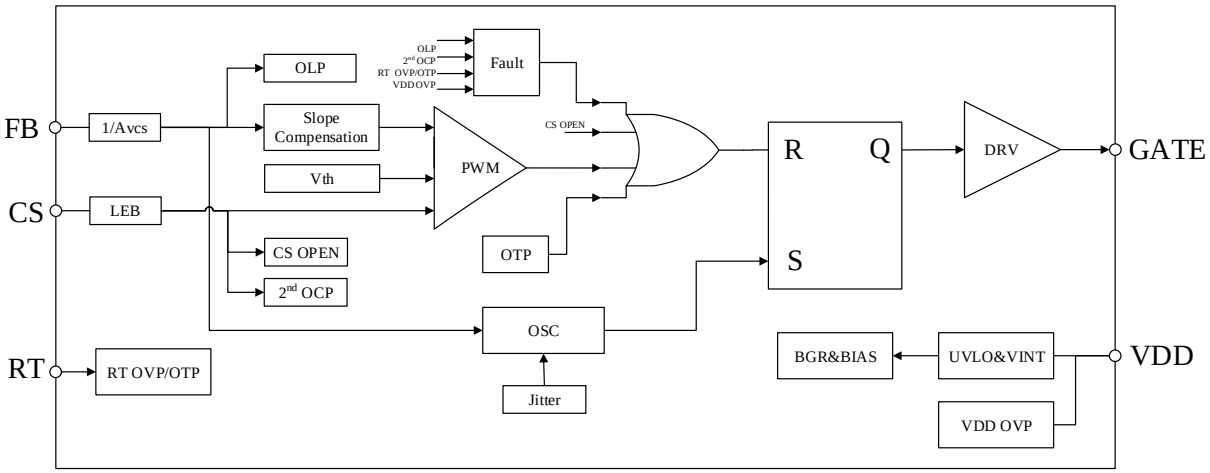
Typical Circuit



Pin Definitions

Pin Name	Pin Number	Pin Function Description
GND	1	Ground
FB	2	Feedback input pin. The PWM duty cycle is determined by voltage level into this pin and CS pin input.
RT	3	Dual functions option Pin, It can achieve OTP or OVP detection. Connecting a resistor from Vaux can adjust OVP trigger voltage; Connecting a resistor to ground can achieve OTP detection.
CS	4	Current sense input pin. Connected to MOSFET current sensing resistor node.
VDD	5	Power supply pin.
GATE	6	Totem-pole gate drive output for the power MOSFET.

Block Diagram



Absolute Maximum Ratings

Supply Voltage Pin VDD.....-0.3~28V
FB Input Voltage.....-0.3~7V
CS Input Voltage.....-0.3~7V
RT Input Voltage..... -0.3~7V
ESD Protection (HBM)..... ±4.0kV
Junction Temperature.....-40~150℃
Storage Temperature Range.....-55~150℃
Lead Temperature (Soldering, 10secs).....260℃

Note：

1. Test standard: ANSI/ESDA/JEDEC JS-001-2017.

Recommended Operating Condition

VDD Voltage.....12~25V
Operating Ambient Temperature.....-40~85℃

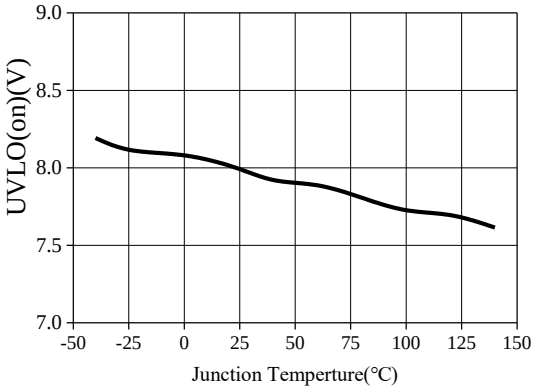
Electrical Characteristics

(T_J =25℃, VDD=18V, unless otherwise specified)

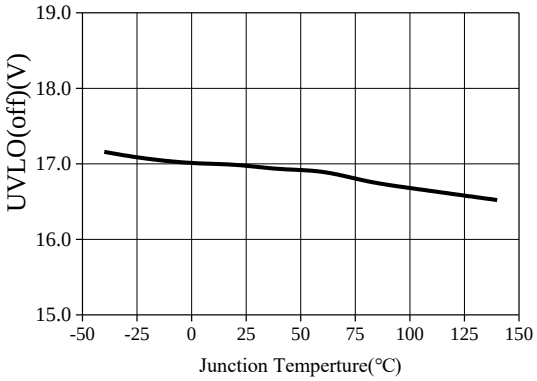
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
SUPPLY section						
VDD Start up Current	Istartup	VCC=UVLO(OFF)-1V		2	5	uA
VDD Operation Current	I_VDD_Op	CS=0.2V		2.5	3	mA
VDD Burst-Mode Current	I_VCC_Burst	CS=0.2V,FB=0.5V		0.55	0.75	mA
VDD Under Voltage Lockout Exit	UVLO(on)		7	8	9	V
VDD Under Voltage Lockout Enter	UVLO(off)		16	17	18	V
Pull-up PMOS active	Vpull-up			10		V
Over voltage protection voltage	OVP		27	31	33	V
VDD latch release voltage	Vlatch_release			5		V
FB section						
VFB Open Loop Voltage	VFB Open			5.1		V
PWM transmission gain	A_{VCS}			3.5		V/V
Maximum Duty Cycle	Maximum duty cycle		70	80	90	%
The threshold enter green mode	Vref_green			1.85		V
The threshold exit burst mode	Vref_burst_H			1.1		V
The threshold enter burst mode	Vref_burst_L			1.0		V
FB pin short circuit current	IFB_Short	Short FB pin to GND and measure current	0.2	0.3	0.4	mA
Power Limiting FB Threshold Voltage	Vth_OLP			4.4		V
Power limiting Debounce Time	Td_OLP			15		ms
Input impedance	Z_{FB}			16		kΩ
CS section						
Soft-start up time	T_SS			4		ms
Over Current protection debounce Time	Td_OCP			60		ms
Leading edge blanking time	T_blanking			350		ns
Internal Current Limiting Threshold Voltage with zero Duty Cycle	Vth_OC		0.459	0.478	0.497	V
Over Current Detection and Control Delay	Td_OC			100		ns
OCP CS voltage clamper	Vth_clamp			0.75		V
Diode short protection voltage	Vth_DSP			1.05		V
Diode short debounce time	Td_DSP			8		cycles

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
RT section						
Output current for external OTP detection	IRT		90	100	110	uA
Threshold voltage for external OTP	VOTP		0.95	1	1.05	V
external OTP debounce time	Td_OTP			30		cycles
Current threshold for adjustable output OVP	Ith_OVP			60		uA
Output OVP debounce time	Td_OVP			6		cycles
OSCILLATOR section						
Normal Oscillation Frequency	Fosc	CS=4V,FB=3V	60	65	70	kHz
Burst Mode Base Frequency	Fosc_BM			25		kHz
Frequency Modulation range	△F_osc			±6		%
Jitter Frequency	F_jitter			32		Hz
Frequency Temperature Stability	△F_Temp			5		%
GATE section						
Output Low Level	VOL				1	V
Output High Level	VOH		6			V
Output Clamp Voltage Level	V_clamping	CS=0V,FB=3V		12		V
Output Rising Time	T_r	1.2V~10.8V@CL=1000pF		100		ns
Output Falling Time	T_f	10.8V~1.2V@CL=1000pF		30		ns
In-chip OTP						
Over Temperature Protection Threshold	OTP enter			150		℃
Over Temperature Protection Exit Threshold	OTP exit			130		℃

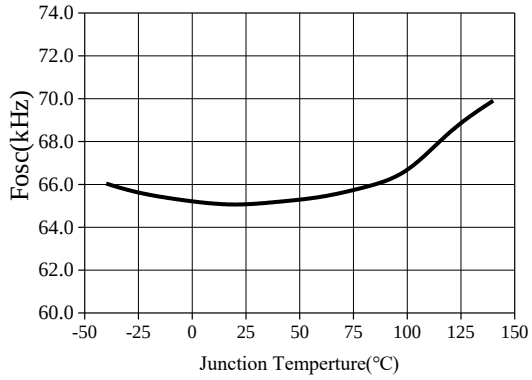
Typical Characteristics Plots



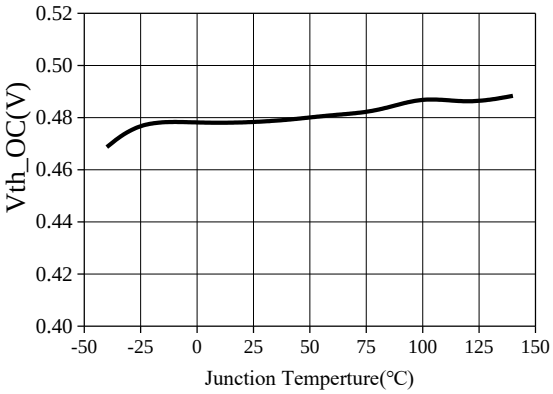
(a) UVLO(on) vs T_j



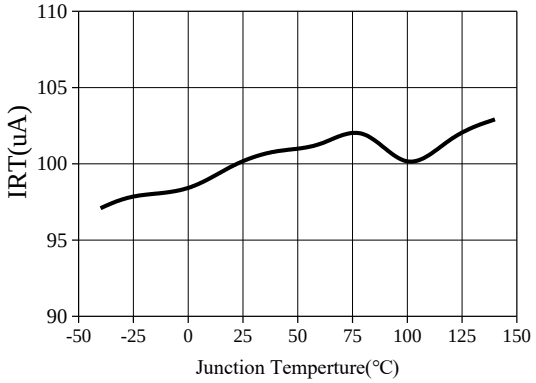
(b) UVLO(off) vs T_j



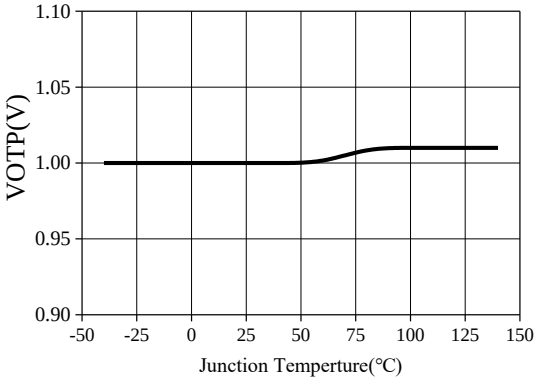
(c) Fosc vs T_j



(d) Vth_oc vs T_j



(e) IRT vs T_j



(f) VOTP vs T_j

Functional Description

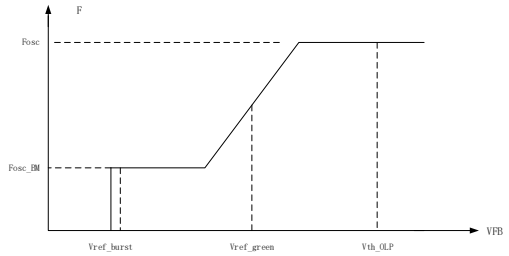
AP8267 is a highly integrated current mode PWM control IC, included all necessary functions to build an easy and cost effective solution for low power supplies to meet the international power conservation requirements.

1. Start-up current

The startup current of AP8267 is designed to be very low so that VDD could be charged up above UVLO (off) threshold level and device starts up quickly. Also a large value startup resistor can be used to minimize the power loss.

2. Green Mode Operation

At light load or no load condition, the switch loss become the major loss of the power supply, to reduce the power wasted in such conditions, based on a special designed voltage controlled oscillator, green mode operation of the power supply can be achieved by using AP8267. The controller will judge the load condition base on the voltage of FB pin. In light load the FB voltage will decrease, when VFB is lower than a set threshold voltage, the operating frequency of the power supply begin to decrease, the minimum frequency is set to above 25kHZ to avoid audio noise. When VFB decrease further, the power supply will enter into burst mode operation to decrease the power consumed.



3. Built-in Slope Compensation

The sensed voltage across the CS resistor and the sample voltage of FB are both used for PWM control, and pulse by pulse current limit. Built-in slope compensation circuit adds a voltage ramp onto the sample voltage. This greatly improves the close loop stability and prevents the sub-harmonic oscillation of peak current mode operation.

4. Gate Driver

The output stage of AP8267 is a fast totem pole gate driver. Dead time has been added to minimize heat dissipation, increases efficiency and enhances reliability. The output driver is clamped by an internal 12V Zener diode in order to protect power MOSFET transistors against undesirable gate over voltage. A soft driving waveform is implemented to minimize EMI.

5. Frequency Jitter

The frequency jitter function is integrated in the controller, the jitter is modulated by a periodic signal, the modulate signal frequency is much smaller than the oscillator frequency, By this way, the EMI noise has a wider spectrum with lower amplitudes.

6. External OTP/Output OVP

A NTC resistor should be connected between RT and GND for temperature sensing and protection. NTC resistor value becomes lower when the ambient temperature rises. With the fixed internal current flowing through the resistors, the voltage at RT pin becomes lower at high temperature. The internal OTP circuit is triggered and shutdown the MOSFET when the sensed input voltage is lower than VOTP.

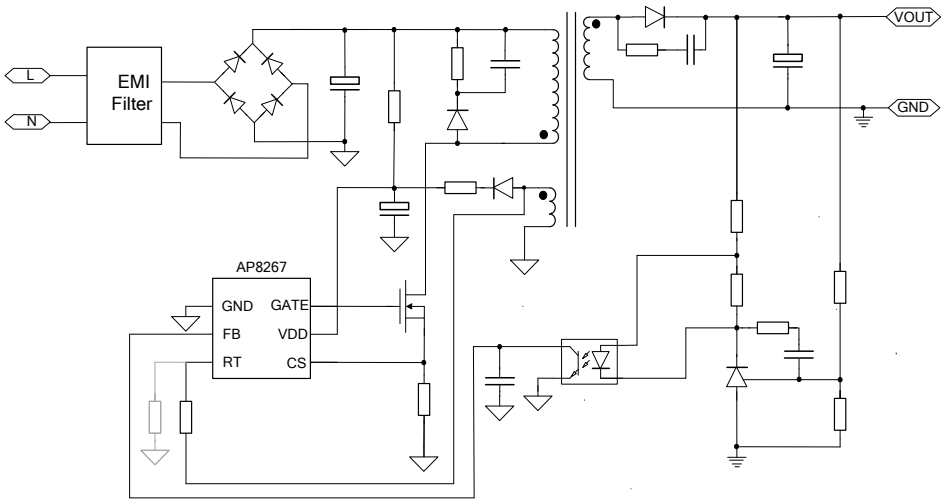
A regular resistor should be connected between RT and the auxiliary winding for output over voltage sensing and protection. The output voltage is detected by the current flowed the resistor. At abnormal condition when the output voltage increases, the current increase simultaneously. Until the current is more than Ith_OVP, control circuit reacts to shut down the MOSFET. The threshold of output over voltage protection can be changed by adjusting the value of the resistor.

7. Protections

To increase the reliability of power supply system, many protection functions are integrated in this controller, including Cycle-by-Cycle current limiting (OCP), VDD over Voltage Protection, Output over voltage protection (OVP), over temperature protection (OTP), Over load Protection (OLP), output diode short protection.

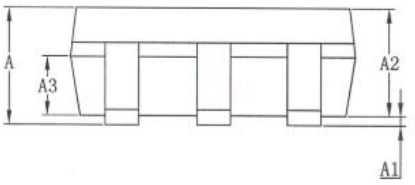
At overload condition when FB input voltage exceeds power limit threshold value for more than Td_OLP (power limit denounce time), the controller reacts to shut down the output power MOSFET. Device restarts when VDD voltage drops below UVLO limit. VDD is supplied by transformer auxiliary winding output. OVP is triggered when VDD is higher than threshold value.

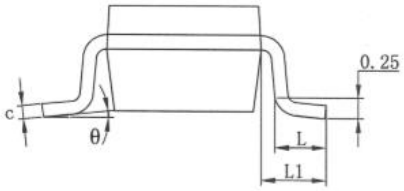
Typical Application

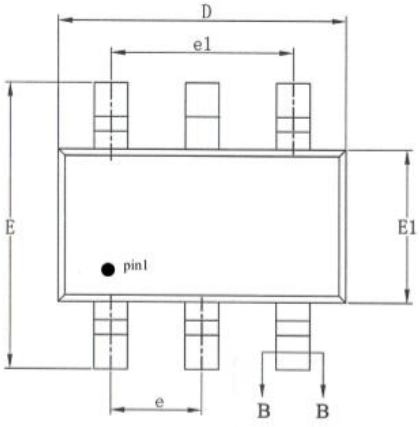


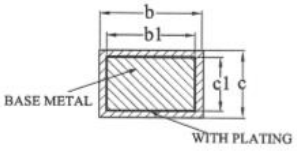
Package Information

Package Information SOT23-6

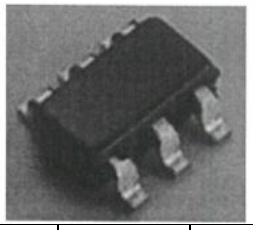








SECTION B-B



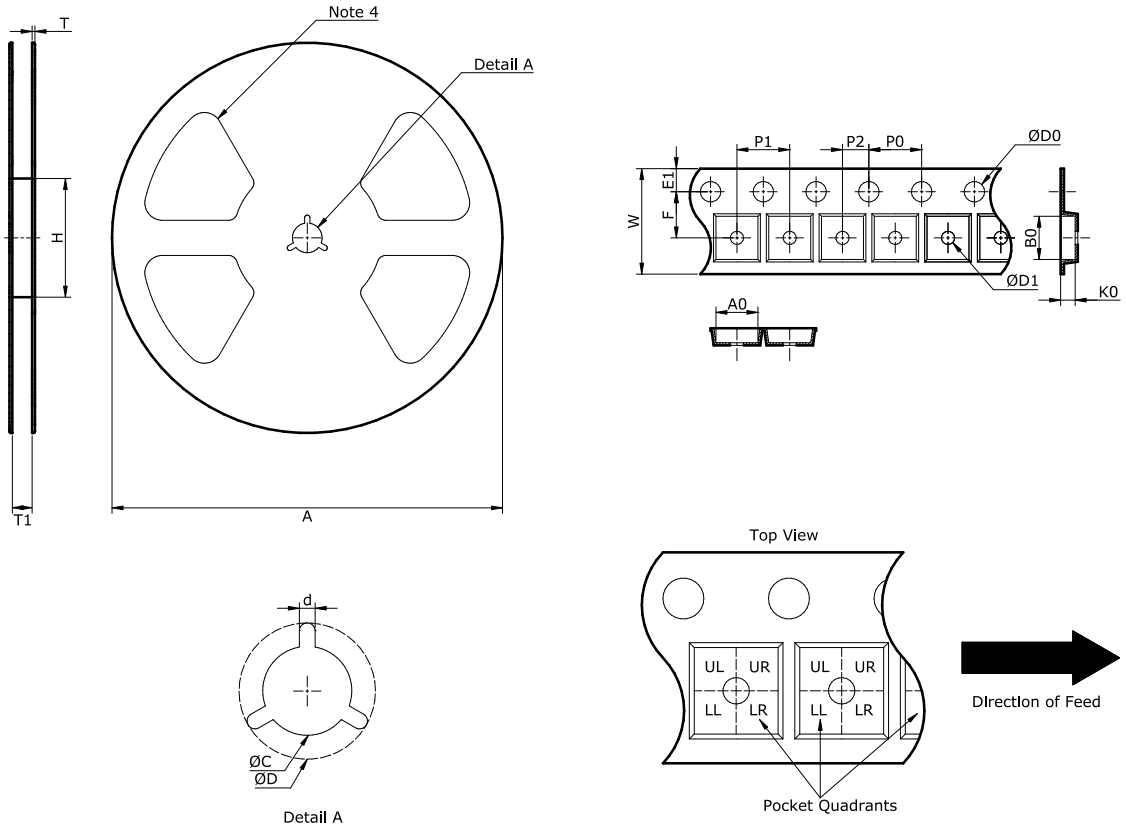
Size / Symbol	Min. (mm)	Typ. (mm)	Max. (mm)	Size / Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	-	-	1.25	D	2.82	2.92	3.02
A1	0.04	-	0.10	E	2.60	2.80	3.00
A2	1.00	1.10	1.20	E1	1.50	1.60	1.70
A3	0.60	0.65	0.70	e	0.95BSC		
b	0.33	-	0.41	e1	1.90BSC		
b1	0.32	0.35	0.38	L	0.30	—	0.60
c	0.15	-	0.19	L1	0.60REF		
c1	0.14	0.15	0.16	θ	0	—	8°

Top mark	Package
62XXX	SOT23-6

Note：XXX：Internal Code

Notes:
1. This drawing is subjected to change without notice.
2. Body dimensions do not include mold flash or protrusion.

Tape and Reel Information



SOT23-6 Package									
A (mm)	**T (mm)**	**T1 (mm)**	**H (mm)**	**ØC (mm)**	**ØD (mm)**	**d (mm)**	**A0 (mm)**	**B0 (mm)**	**K0 (mm)**
180 +0/-3	1.4 ±0.3	9.5 ±1.0	60 ±0.5	13.00 ±0.20	18.70 ±0.40	2.30 ±0.10	3.17 ±0.10	3.10 ±0.10	1.10 ±0.10
W (mm)	**F (mm)**	**E1 (mm)**	**P0 (mm)**	**P1 (mm)**	**P2 (mm)**	**ØD0 (mm)**	**ØD1 (mm)**	**Pin 1 Quadrant**	
8.0 +0.3/-0.1	3.5 ±0.10	1.75 ±0.10	4.0 ±0.10	4.0 ±0.10	2.0 ±0.05	1.5 +0.1/-0	1.0 +0.25/-0	LL	

Notes:
1. This drawing is subjected to change without notice.
2. All dimensions are nominal and in mm.
3. This drawing is not in scale and for reference only. Customer can contact Chipown sales representative for further details.
4. The number of flange openings depends on the reel size and assembly site. This drawing shows an example only.

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