1 MHz, 2 A Step up Regulator with Adjustable Current Limit

General Description

AP2008A is an asynchronous PWM boost converter using a constant frequency peak current mode. An external Schottky diode is needed. At light load, AP2008A works in the light load mode. The supply current during the light mode is 200 μA , together with the 200 mΩ internal NMOS power transistor guarantees high efficiency in the whole output load current range. OC pin is floating, AP2008A can provide 0.8 A output load current, which is suitable to use as MID and mobile power supply. The input voltage 3 V~12 V. The operating frequency is internally set at 1.0 MHz.

The device is available in the small profile SOT-23-6L package.

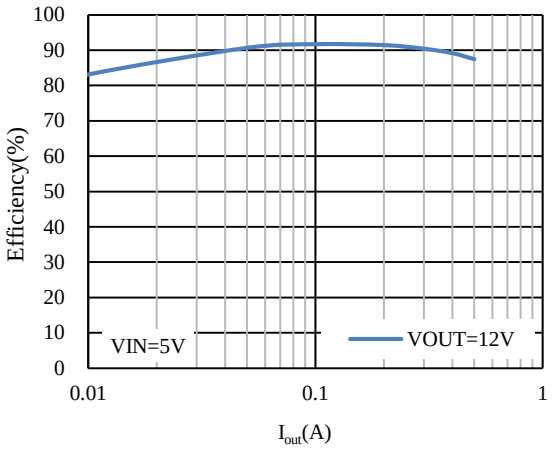
Applications

- WLED Drivers
- Networking cards powered from PCI or PCI-express slots
- MID and Mobile Power

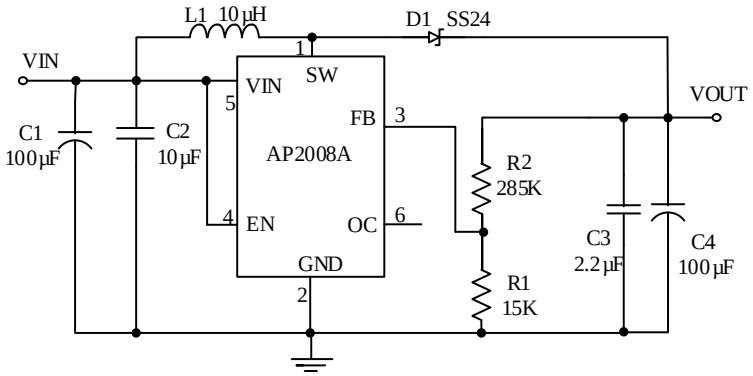
Features

- Wide input range: 3 V-12 V, 20 Vout max
- High Efficiency: Up to 92 %
- 1.0 MHz Constant Switching Frequency
- Switch current up to 2 A
- Low Rdson: 0.2 Ω
- Accurate Reference:0.6 V
- Tiny External Components
- Space Saving 6-Pin SOT23 Package

Typical Application Efficiency



Typical Application Circuit



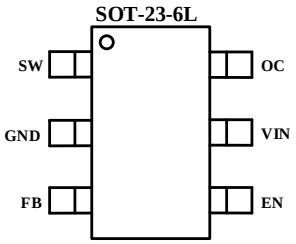
Ordering Information

Part number	Mark	Package
AP2008TC-A1	U2XYL (1)	SOT-23-6L

(1).XY=Date Code

L= Package Information

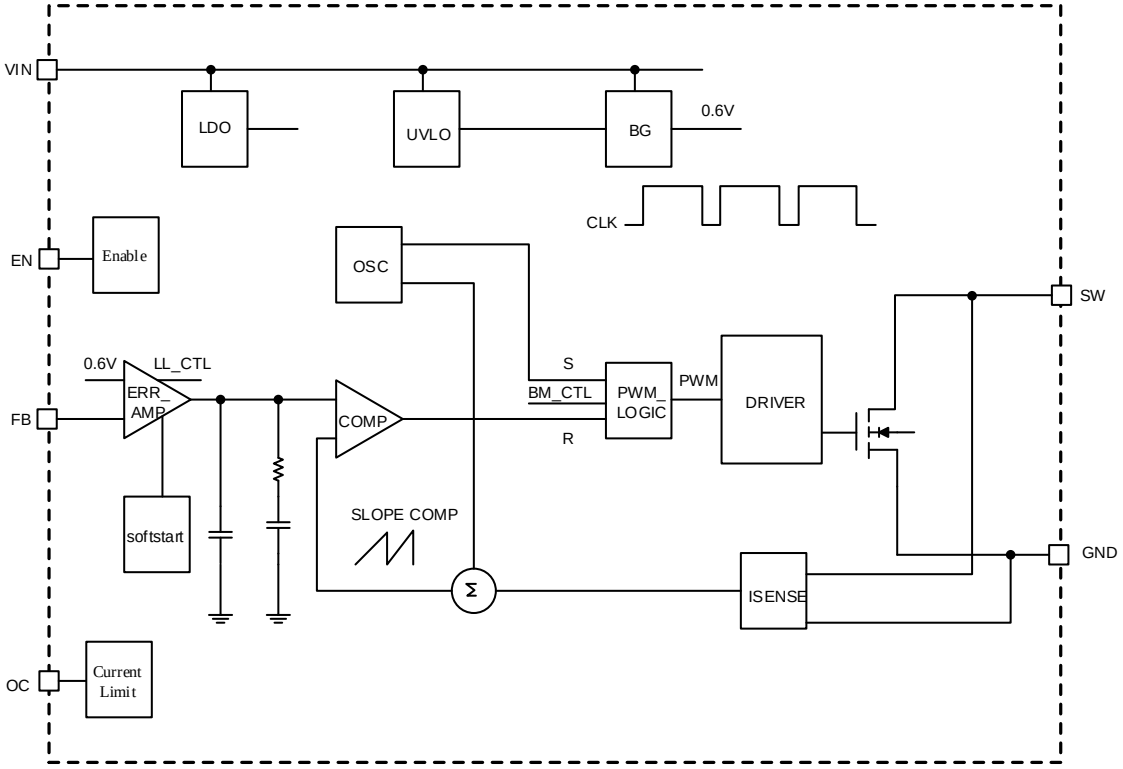
Pin Configuration



Pin Description

Pin No.	Pin Name	Pin Function
1	SW	Power Switch Pin. It is the switch node connection to Inductor.
2	GND	Ground Pin.
3	FB	Feedback Input Pin. Connect FB to the center point of the external resistor divider. The feedback threshold voltage is 0.6V.
4	EN	Chip Shutdown Signal Input. Logic high is normal operation mode, Logic Low is Shutdown. Don't leave it floated.
5	VIN	Power Supply Input. Must be closely decoupled to GND, Pin 2, with a 10μF or greater ceramic capacitor.
6	OC	Adjustable current limit. Floating is the maximum current limit.

Functional Block Diagram



Absolute Maximum Rating (1)

VIN, EN Voltages……..…..…….-0.3 V to +16 V
SW Voltage……..…..…….-0.3 V to +24 V
FB, OC Voltages……..……..…..-0.3 V to +6 V
ESD Rating (Human Body Model)..... ±2 kV(2)

Package Thermal Resistance
Θ_{JA} (3).....160 ℃/W
Θ_{JC} (4).....40 ℃/W
Operating Temperature Range…..….-40 ℃ to +85 ℃
Storage Temperature Range……-55 ℃ to +150 ℃
Lead Temperature (Soldering, 10s)……+260 ℃

(1). All voltages refer to GND pin unless otherwise noted; Stresses exceed those ratings may damage the device.
(2). Tested and classified as Class 3A per ESDA/JEDEC JDS-001-2017.
(3). Soldered to 100 mm^2, 1 oz copper clad.
(4). Measured on pin 1(SW) Close to plastic interface.

Electrical Characteristics (1)

(V_{OUT}=12V, T_A = 25 ℃, unless otherwise noted.)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit.
Input						
Input Voltage Range	V_{IN}	V_{IN} Rising	3		12	V
UVLO Rising Threshold	V_{UVLO}	V_{IN} Rising			2.7	V
UVLO Hysteresis	$UVLO_{HYS}$			0.3		V
Input Supply Current						
Quiescent Current	I_Q	FB=0.66 V, No switch		200		μA
Shutdown Current	I_{SHDN}	EN=0			1	μA
Output Voltage						
Feedback Reference Voltage	V_{FB}	V_{IN}=5 V,IO=10 mA	0.588	0.6	0.612	V
Oscillator						
Switching Frequency	F_{SW}	V_{IN}=5 V,IO=300 mA	0.8	1	1.3	MHz
Maximum Duty Cycle (2)	D_{MAX}			97		%
MOSFET						
Low Side Main FET RON	$R_{DS(ON)}$			200		mΩ
Main FET Current Limit	I_{LIM1}			2		A
Enable						
EN High Level Input Voltage	V_{ENH}				1.9	V
EN Low High Level Input Voltage	V_{ENL}		0.4			V
Thermal Shutdown						
Thermal Shutdown Temperature	T_{SD}			150		℃

(1). Specifications over temperature range are guaranteed by design and characterization.
(2). Guaranteed by design and characterization only.

Functional Descriptions

1. Operation

The AP2008A uses a fixed frequency, peak current mode boost regulator architecture to regulate voltage at the feedback pin. The operation of the AP2008A can be understood by referring to the block diagram. At the start of each oscillator cycle the MOSFET is turned on through the control circuitry. To prevent subharmonic oscillations at duty cycles greater than 50 percent, a stabilizing ramp is added to the output of the current sense amplifier and the result is fed into the negative input of the PWM comparator. When this voltage equals the output voltage of the error amplifier the power MOSFET is turned off. The voltage at the output of the error amplifier is an amplified version of the difference between the 0.6 V bandgap reference voltage and the feedback voltage. In this way the peak current level keeps the output in regulation. If the feedback voltage starts to drop, the output of the error amplifier increases. These results in more current to flow through the power MOSFET, thus increasing the power delivered to the output. The AP2008A has internal soft start to limit the amount of input current at startup and to also limit the amount of overshoot on the output.

2. Adjustable Peak Current Limit

The peak current limit prevents the AP008A from high inductor current and from drawing excessive current from the input voltage rail. Excessive current might occur with a shorted/saturated inductor or a heavy load condition. If the inductor current reaches the peak limit threshold, the main switch is turned off and the external Schottky diode is turned on to ramp down the inductor current. The peak current limit is programmable through the external resistor 'R3' connected between the OC pin and ground.

For a current limit of 1.8 A, the resistor should be set at 30 kΩ. The minimum of the peak current limit must be higher than the required peak switch current at the lowest input voltage and highest output power to ensure the peak switch current will not be hit under normal operation. Figure 4 shows the relationship between the Current Limit and the Setting Resistance.

Application Information

1. Setting the Output Voltage

The internal reference VREF is 0.6V (Typical).The output voltage is divided by a resistor divider, R1 and R2 to the FB pin. The output voltage is given by

$$V_{OUT} = 0.6V \times \left(1 + \frac{R2}{R1}\right)$$

2. Inductor Selection

The recommended values of inductor is 10μH. Small size and better efficiency are the major concerns for portable device. The inductor should have low core loss at 1.0 MHz and low DCR for better efficiency. To avoid inductor saturation current rating should be considered.

3. Capacitor Selection

Input ceramic capacitor of 10μF is recommended for AP2008A applications. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable because of their wider voltage and temperature ranges.

4. Diode Selection

Schottky diode is a good choice for AP2008A because of its low forward voltage drop and fast reverses recovery. Using Schottky diode can get better efficiency. The high speed rectification is also a good characteristic of Schottky diode for high switching frequency. The average current rating must be greater than the 1.5 times value of maximum load current expected, and the peak current rating must be greater than the peak inductor current. The diode's reverse breakdown voltage should be larger than the 1.25 times value of output voltage.

Layout Consideration

For best performance of the AP2008A, the following guidelines must be strictly followed.

- Input and Output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
- The GND should be connected to a strong ground plane for heat sinking and noise protection.
- Keep the main current traces as possible as short and wide.
- SW node of DC-DC converter is with high frequency voltage swing. It should be kept at a small area.
- Place the feedback components as close as possible to the IC and keep away from the noisy device

Typical Performance Characteristics

All curves taken at V_{IN} = 5 V, V_{OUT} = 12 V with configuration in Typical Application Circuit shown in this datasheet. T_A = 25 ℃, unless otherwise specified.

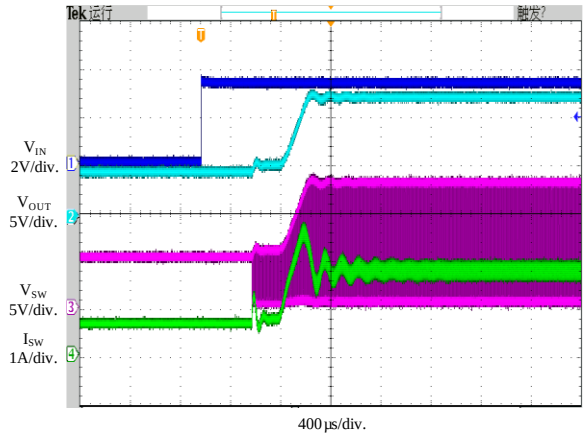


Figure 1. Startup Waveforms

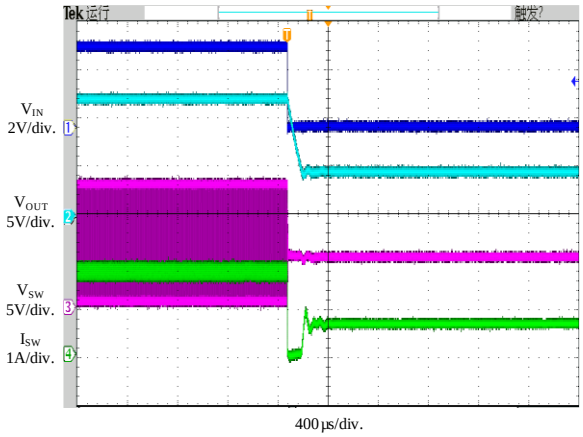


Figure 2. Shutdown Waveforms

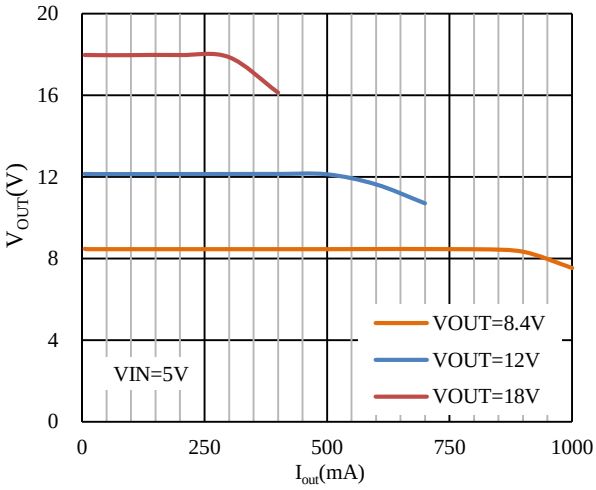


Figure 3. V_{OUT} vs. Load Current

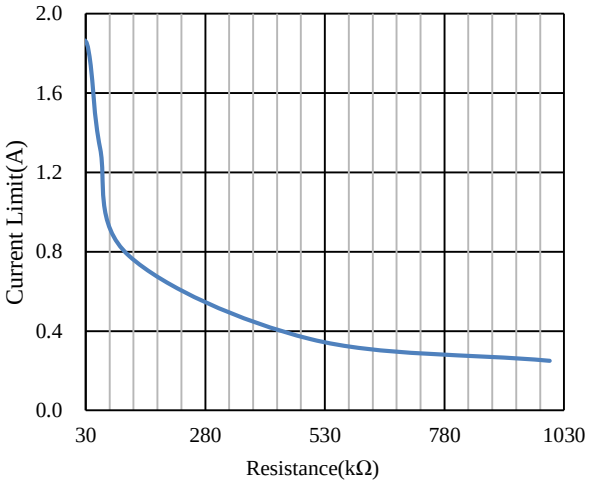


Figure 4. Current Limit vs. Resistance

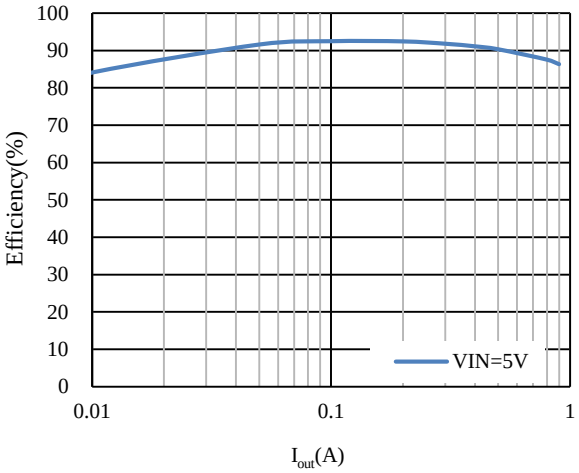


Figure 5. Efficiency vs. Load Current, VOUT = 8.4 V

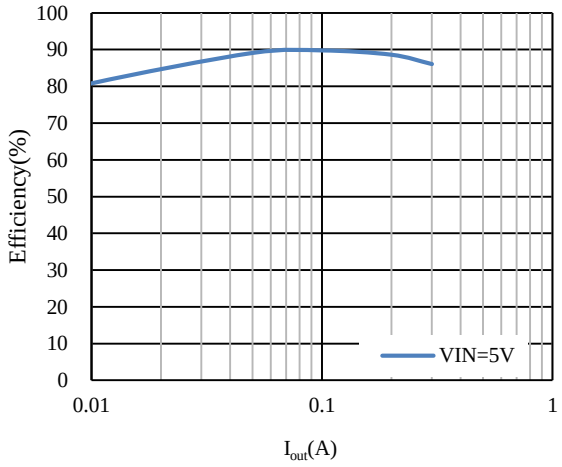
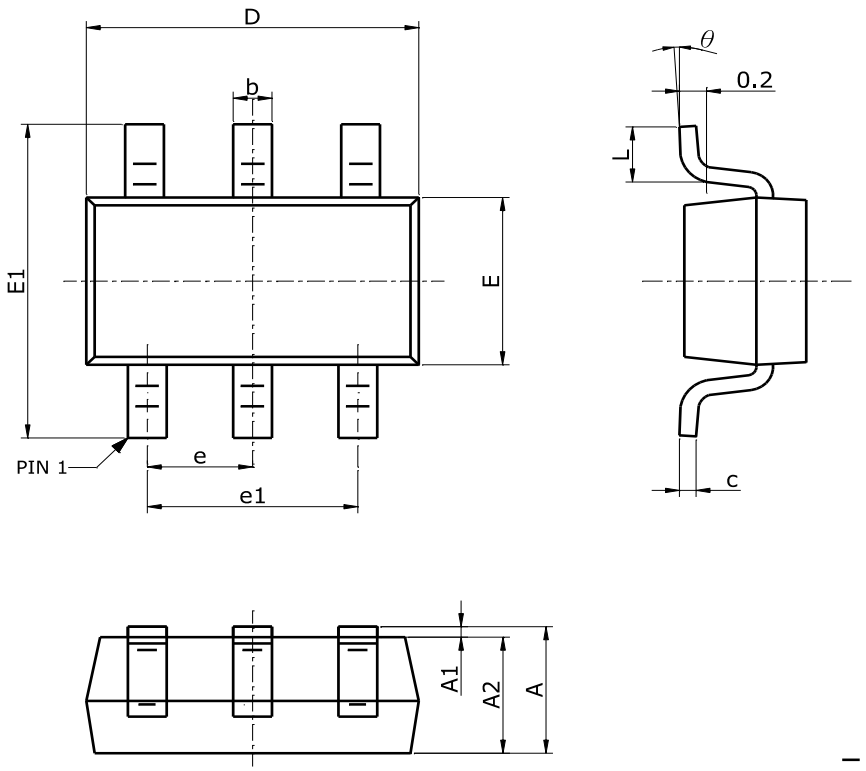


Figure 6. Efficiency vs. Load Current, VOUT = 18 V

Package Information

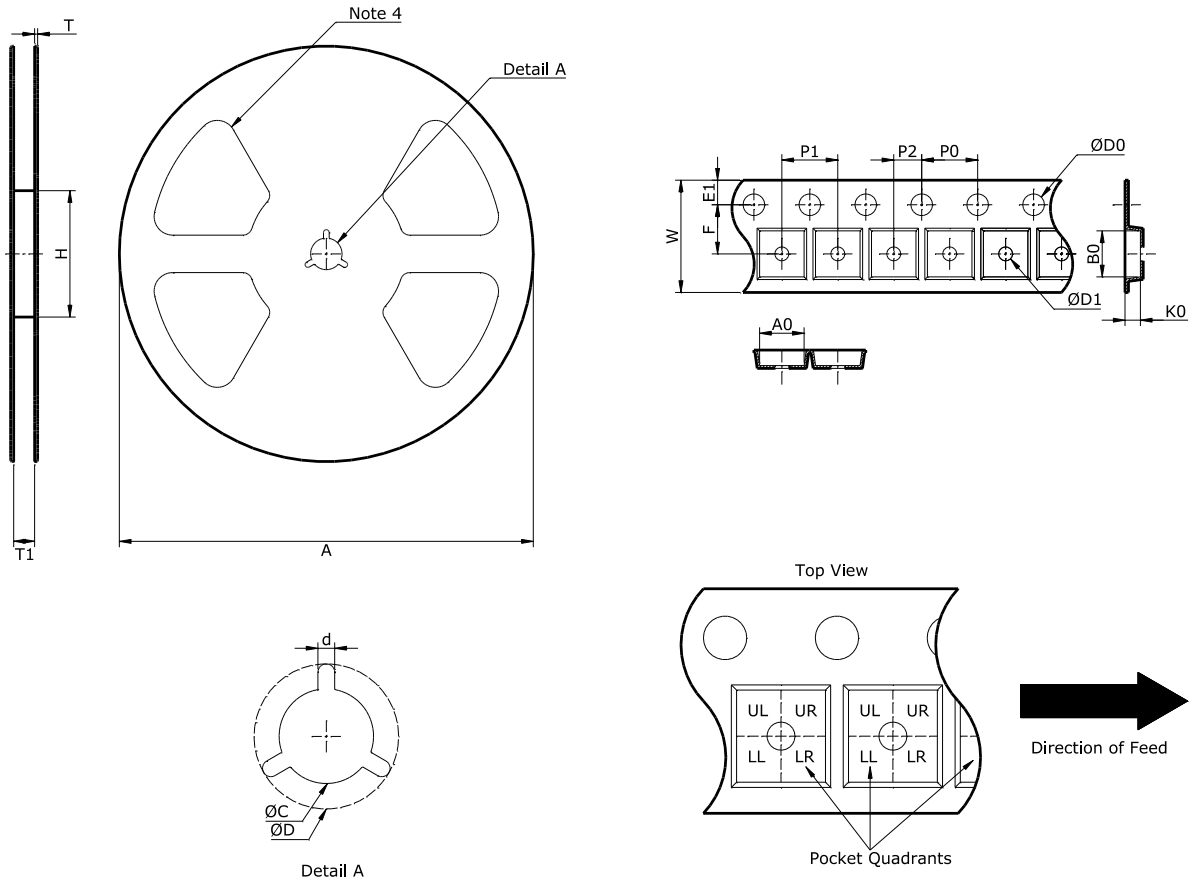
Package Outline and Dimensions



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0 °	8 °	0 °	8 °

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

Tape and Reel Information



A (mm)	T (mm)	T1 (mm)	H (mm)	ØC (mm)	ØD (mm)	d (mm)	A0 (mm)	B0 (mm)	K0 (mm)
180	1.4	9.5	60	13.00	18.70	2.30	3.17	3.10	1.10
W (mm)	**F (mm)**	**E1 (mm)**	**P0 (mm)**	**P1 (mm)**	**P2 (mm)**	**ØD0 (mm)**	**ØD1 (mm)**	**Pin 1 Quadrant**	
8.00	3.5	1.75	4.0	4.0	2.0	1.5	1.0	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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