

## 200mA 1-Wire Configurable Front Flash LED Driver with Ultra Small Package

### FEATURES

- Front Flash LED Driving
- 200mA Maximum Flash Current
- 16 Steps Current 1-wire Pulse Configurable, 12.5mA/step
- LED Current Accuracy:  $\pm 15\%$
- Low Dropout Voltage: 65mV@200mA (Typ.)
- Efficiency: 94% ( $V_{IN}=3.6V$ ,  $V_F=3.4V$ )
- Shutdown Current:  $<0.1\mu A$
- Ultra Small  $1.5 \times 1.0 \times 0.55\text{mm}^3$  DFN-6L Package

### APPLICATION

- Front Camera Flash
- LED Torch Mode

### TYPICAL APPLICATION CIRCUIT

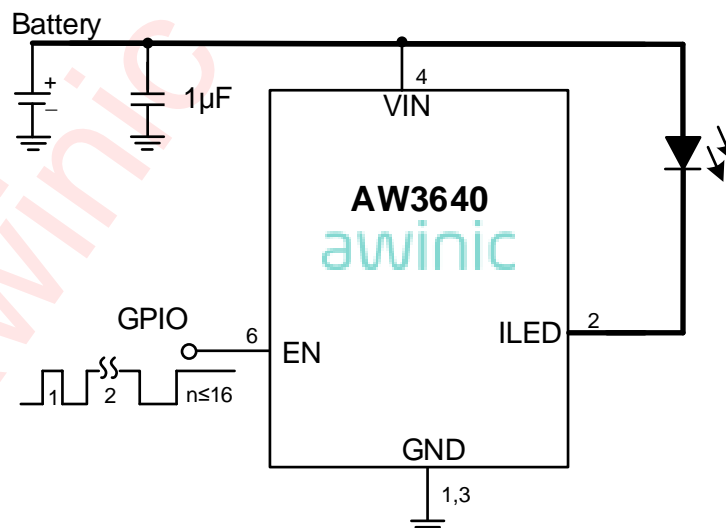


Figure 1 AW3640 Application Circuit for Single LED

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### GENERAL DESCRIPTION

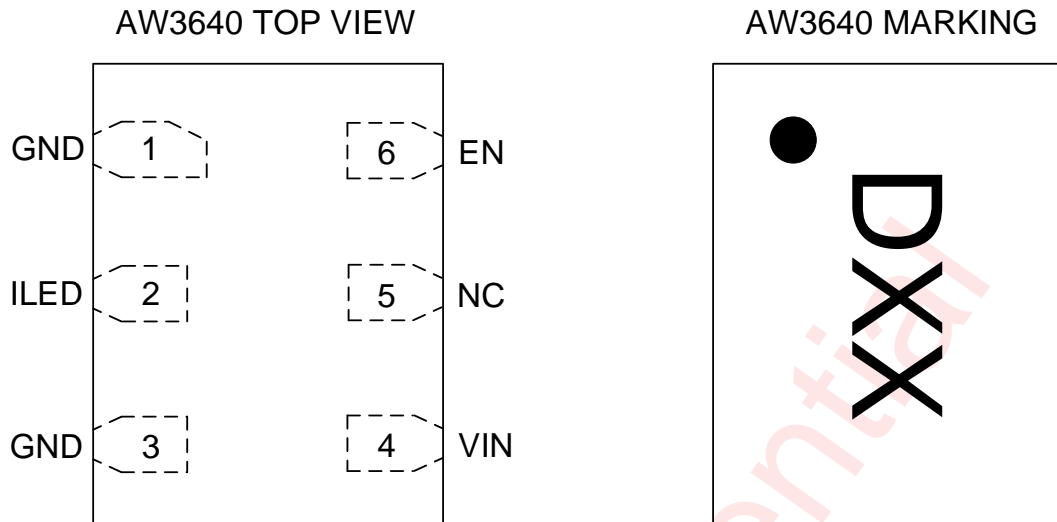
AW3640 is a low voltage-drop current sink LED driver, which supports both Torch and Flash modes. The current-regulation sink integrated in the chip make the LED current capable of keeping constant when input voltage, LED forward voltage or temperature changing. The LED current can be adjusted among 16 steps by sending 1-wire pulse into the EN pin, and the maximum value is 200mA.

AW3640 is available in an ultra small  $1.5\text{mm} \times 1.0\text{mm} \times 0.55\text{mm}$  DFN-6L package. And only one multi-layer ceramic capacitor is needed for the peripheral of the solution.

In shut down mode, AW3640 turns off all internal circuit and the consumption is less than  $0.1\mu A$ .

The device requires 2.8V~5.5V input voltage range and an operating temperature range of  $-40\sim 85^\circ\text{C}$ .

## PIN CONFIGURATION AND TOP MARK



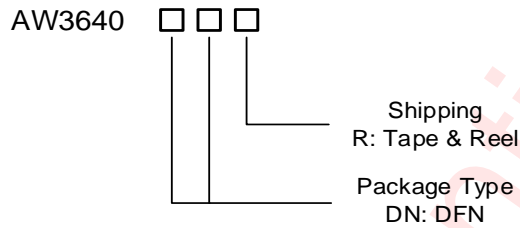
D ---- AW3640DNR  
XX ---- Manufacture trace code

## PIN DEFINITION

No.	NAME	DESCRIPTION
1	GND	Ground.
2	ILED	Open drain current sink pin, connected to LED cathode.
3	GND	Ground.
4	VIN	Power Supply (2.8V-5.5V)
5	NC	Not connected.
6	EN	Enable pin. LED current can be adjusted by sending 1-wire pulse into this pin.

## ORDERING INFORMATION

Part Number	Temperature	Package	Moisture Sensitivity Level	Environmental Information	Marking	Delivery Form
AW3640DNR	-40°C ~ 85°C	1.5mm×1.0mm DFN-6L	MSL1	ROHS+HF	D	Tape and Reel 3000pcs/Reel



## TYPICAL APPLICATION CIRCUITS

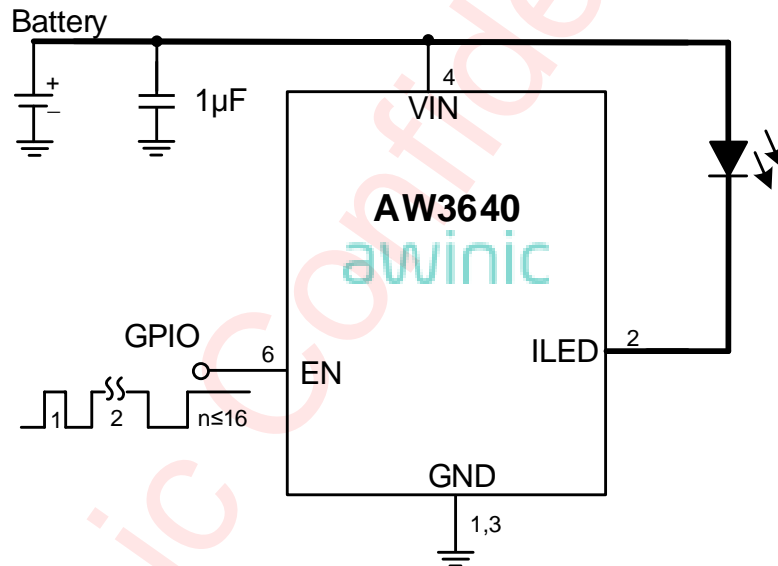


Figure 2 AW3640 Application Circuit for Single LED

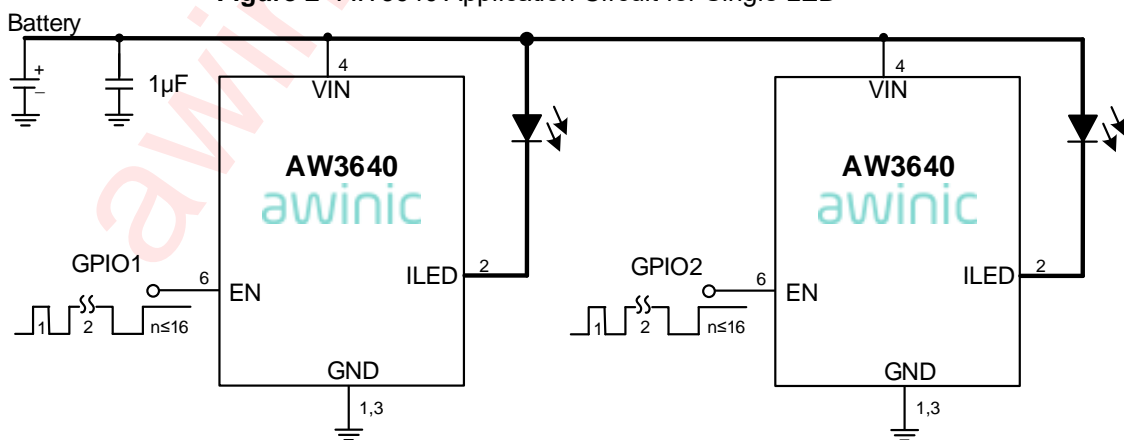


Figure 3 AW3640 Application Circuit for Dual LEDs

## ABSOLUTE MAXIMUM RATINGS<sup>(NOTE1)</sup>

PARAMETERS		Range	Unit
VIN, ILED		-0.3 to 6	V
EN		-0.3 to (VIN+0.3)	V
Max Junction Temperature T <sub>JMAX</sub>		125	°C
Storage Temperature T <sub>STG</sub>		-65 to 150	°C
Maximum lead temperature (soldering)		260	°C
Junction to Ambient Thermal Resistance $\theta_{JA}$		148.2	°C/W
ESD, All Pins <sup>(NOTE2)</sup>	HBM	2000	V
	MM	200	V
	CDM	1000	V
Latch-Up JEDEC STANDARD NO.78B DECEMBER 2008		+IT: +300 -IT: -300	mA

## RECOMMENDED OPERATING CONDITIONS

PARAMETERS		Range	Unit
V <sub>IN</sub>		2.8 to 5.5	V
Junction temperature (T <sub>J</sub> )		-40 to 125	°C
Ambient temperature (T <sub>A</sub> )		-40 to 85	°C

*NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.*

*NOTE2: The human body model is a 100pF capacitor discharged through a 1.5k $\Omega$  resistor into each pin. Test method: MIL-STD-883G Method 3015.7*

## ELECTRICAL CHARACTERISTICS

$V_{BAT}=3.8V$ ,  $T_A=25^{\circ}C$  for typical values (unless otherwise noted)

Symbol	Description	Test Conditions	Min	Typ.	Max	Units
<b>Power supply</b>						
$V_{IN}$	Input operation voltage		2.8		5.5	V
$I_{SHUTDOWN}$	Current in Shutdown mode	EN=0		0.1	1	$\mu A$
$I_Q$	Quiescent Current in Active mode	EN=1, ILED floating		255		$\mu A$
<b>Digital Logical Interface</b>						
$V_{IL}$	Logic input low level				0.4	V
$V_{IH}$	Logic input high level		1.3			V
$R_{EN}$	Pull down resistor inside			100		k $\Omega$
<b>1-Wire Dimming Pulse Timing</b>						
$T_{LO}$	EN pulse low time		0.5		500	$\mu s$
$T_{HI}$	EN pulse high time		0.5			$\mu s$
$T_{SHDN}$	Chip shutdown delay	Measure from EN falling edge to the chip entering shutdown mode	0.8		2.5	ms
<b>LED Driver</b>						
$I_{LED}$	Current accuracy	$I_{LED}=200mA$	170	200	230	mA
$V_{DROP}$	Dropout voltage	$I_{LED}=200mA$		65	100	mV

## FUNCTIONAL BLOCK DIAGRAM

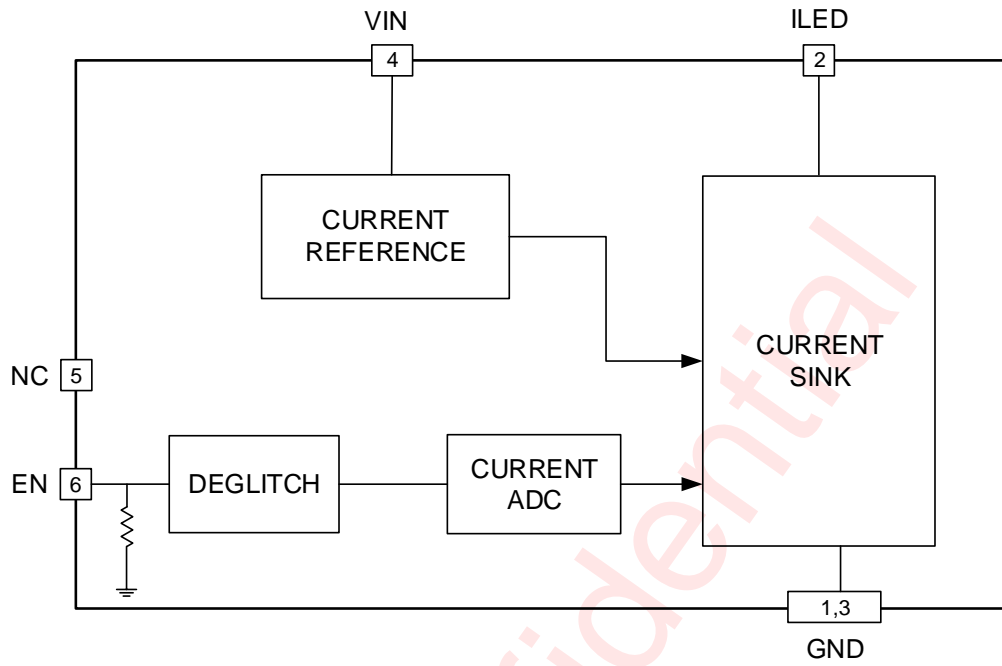


Figure 4 AW3640 Functional Block

## TYPICAL CHARACTERISTICS

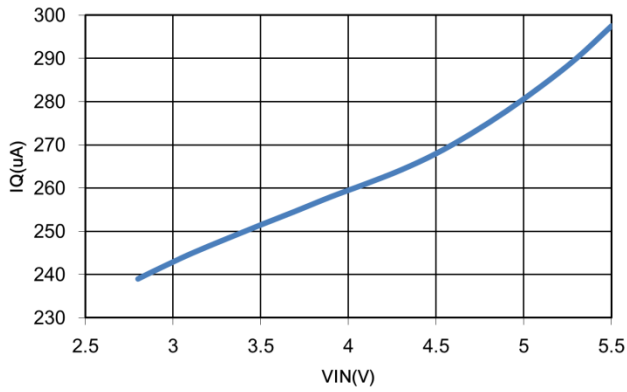


Figure 5 Quiescent Current vs. Input Voltage

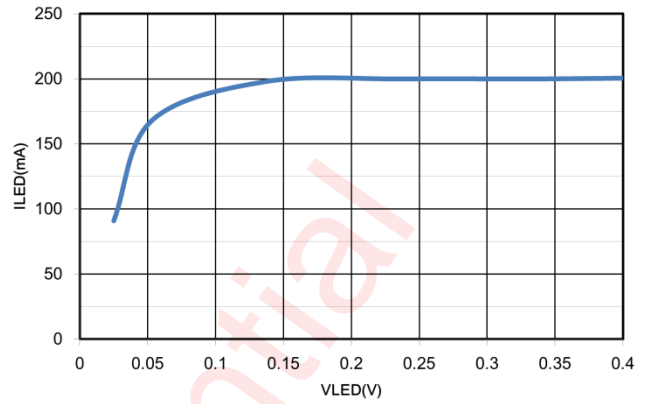


Figure 6 LED Current vs. ILED pin Voltage

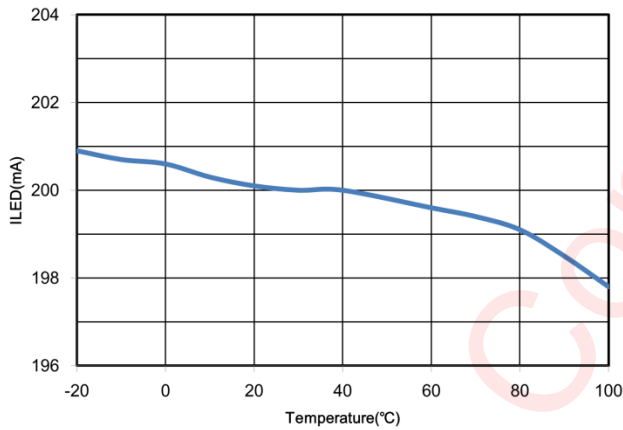


Figure 7 LED Current vs. Temperature

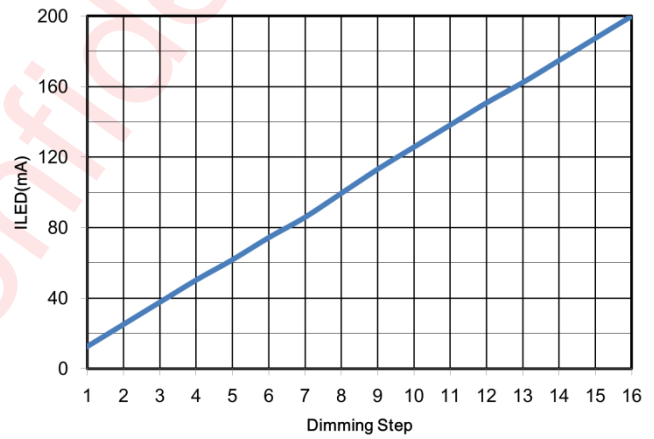


Figure 8 LED Current vs. 1-Wire Dimming Step

## DETAILED DESCRIPTION

AW3640 is a low voltage-drop current sink LED driver, which supports both Torch and Flash modes. The current-regulation sink integrated in the chip make the LED current capable of keeping constant when input voltage, LED forward voltage or temperature changing. The LED current can be adjusted among 16 steps by sending 1-wire pulse into the EN pin, and the maximum value is 200mA.

### ENABLE CONTROL

The voltage level at EN pin determines the operation state of the chip. When the EN pin is set to high, AW3640 operates in normal state. And the chip would enter shutdown mode if the EN pin is set to low for over 2.5ms, as a built-in shutdown delay circuit in AW3640. The shutdown current dissipated by AW3640 is less than 0.1  $\mu$  A.

### GLITCH ELIMINATION

AW3640 built in deglitch circuit. The interference between signals inside the portable device is unavoidable, thus deglitch circuit is necessary at the EN pin. The deglitch circuit inside AW3640 is capable of eliminating the glitch which is narrower than 80ns, preventing the incorrect trigger at the EN pin effectively.

## APPLICATION INFORMATION

### 1-WIRE PULSE DIMMING

AW3640 adopts the 1-wire pulse dimming to avoid the switch noise. A 4-bit DAC inside AW3640 allows counting the rising edge at the EN pin to set the LED current (refer to Figure 5 and Table 1). Figure 5 shows that the first high level hold time  $T_{ON}$  should be over  $20\mu s$  to make sure the chip start up regularly, and meantime setting the LED current to the maximum value. Other EN pulse timing requirements include normal high level time  $T_{HI}$  should longer than  $0.5\mu s$ , and low level time  $T_{LO}$  should between  $0.5\mu s$  and  $500\mu s$ .

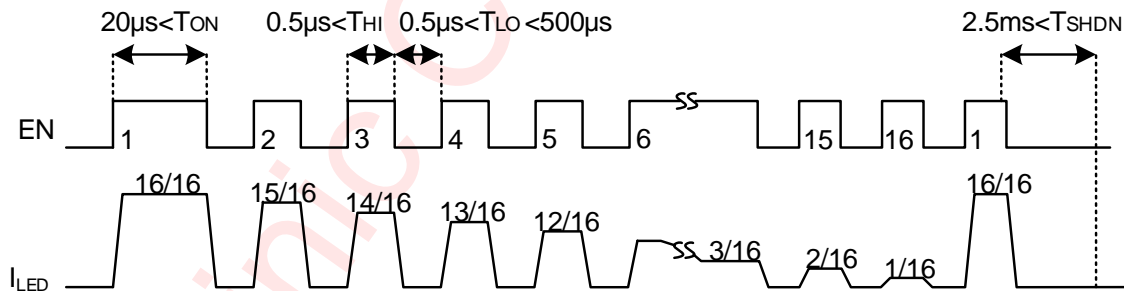


Figure 9 AW3640 1-wire dimming timing diagram

The LED current steps down along with the increasing EN pulse rising edge number as shown in table 1. After the current set process, the EN pin should set to high level.

**Table 1** LED Current vs. EN Rising Edge Number

EN Rising Edge Number	LED Current (Ma)	EN Rising Edge Number	LED Current (Ma)
1	200	9	100
2	187.5	10	87.5
3	175	11	75
4	162.5	12	62.5
5	150	13	50
6	137.5	14	37.5
7	125	15	25
8	112.5	16	12.5

## EFFICIENCY

AW3640 is a low voltage-drop current sink LED driver, its operation efficiency can be approximately calculated as below.

$$\eta = \frac{P_{OUT}}{P_{IN}} = \frac{V_F \times I_{OUT}}{V_{IN} \times I_{IN}} \approx \frac{V_F \times I_{OUT}}{V_{IN} \times I_{OUT}} = \frac{V_F}{V_{IN}}$$

$V_F$  in the formula represents the forward voltage of LED. If  $V_{IN}$  is 3.6V,  $V_F$  is 3.4V, the chip efficiency is about 94%.

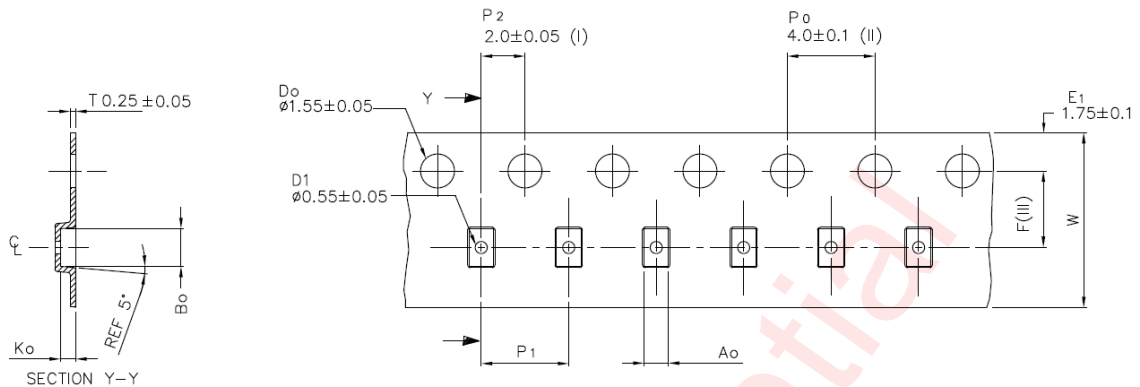
## PCB LAYOUT CONSIDERATION

To make fully use of the performance of AW3640, the guidelines below should be followed.

- 1、 All the peripherals should be placed as close to the device as possible. Place the input capacitor  $C_{IN}$  on the top layer (same layer as the AW3640) and close to  $V_{IN}$  (pin4).
- 2、 Route the power line (shown in Figure 2) as widely and shortly as possible to reduce parasitic impedance.
- 3、 To optimize the heat dissipation performance, the GND pins (pin1 & 3) should be connected to the PCB ground plane using as many vias as possible.

## TAPE AND REEL INFORMATION

### CARRIER TAPE

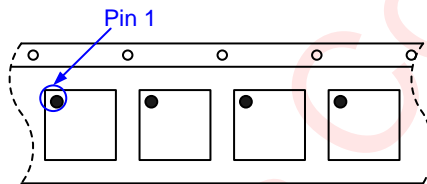



Ao	1.12	+/-0.05
Bo	1.72	+/-0.05
Ko	0.70	+/-0.05
F	3.50	+/-0.05
P1	4.00	+/-0.1
W	8.00	+0.3/-0.1

- (I) Measured from centreline of sprocket hole to centreline of pocket.
- (II) Cumulative tolerance of 10 sprocket holes is  $\pm 0.20$ .
- (III) Measured from centreline of sprocket hole to centreline of pocket.
- (IV) Other material available.

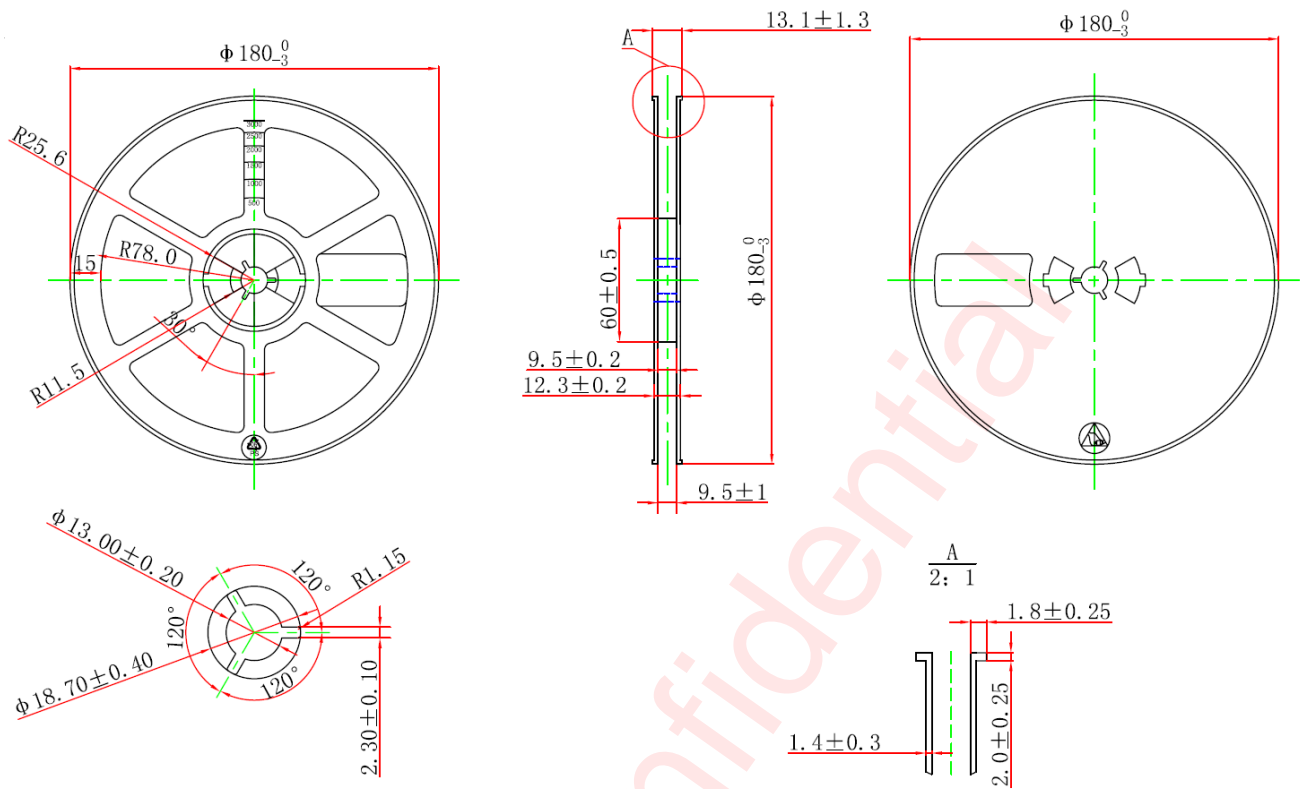
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE STATED.

### PIN1



  
User Direction of Feed

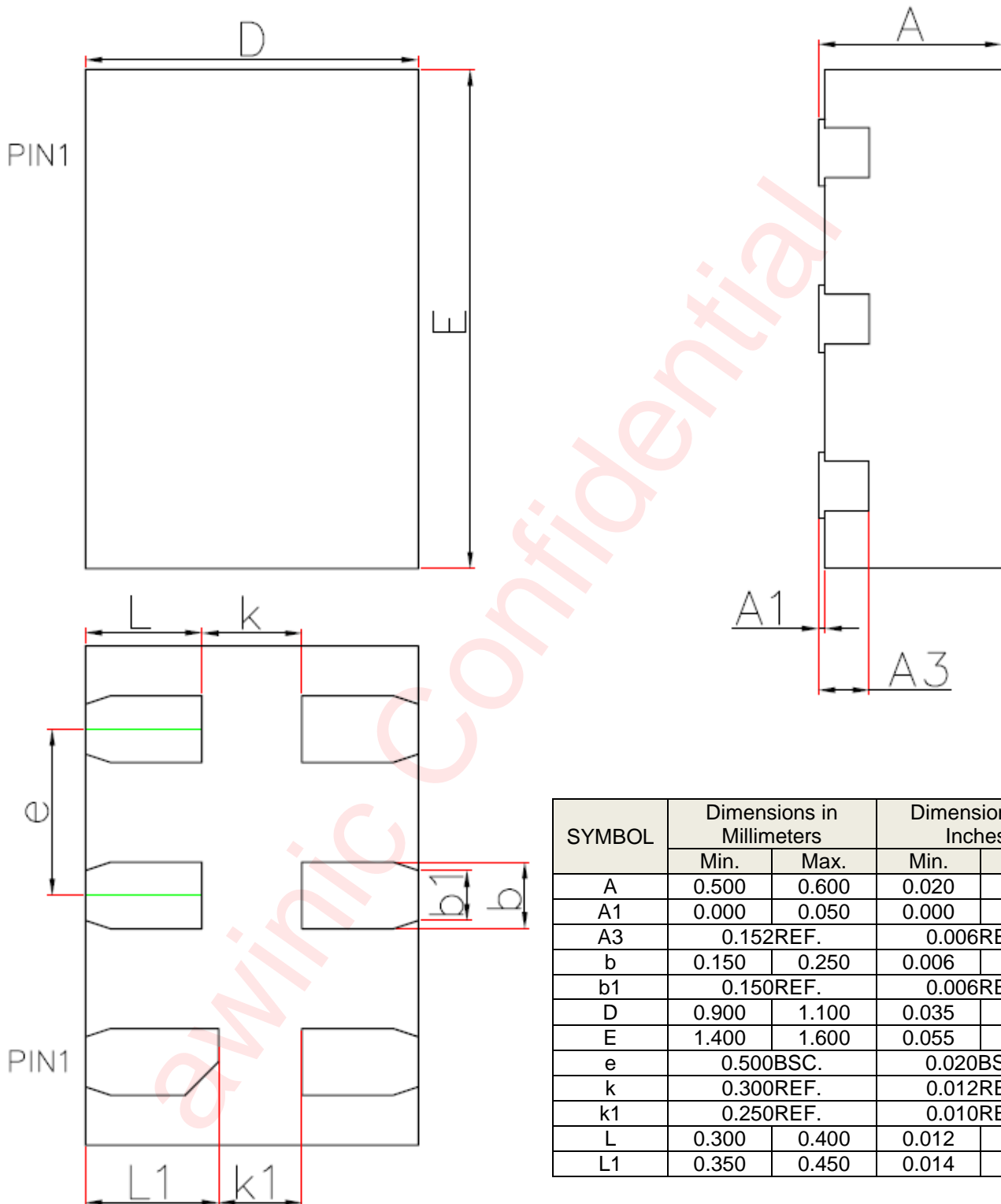
REEL



NOTE:

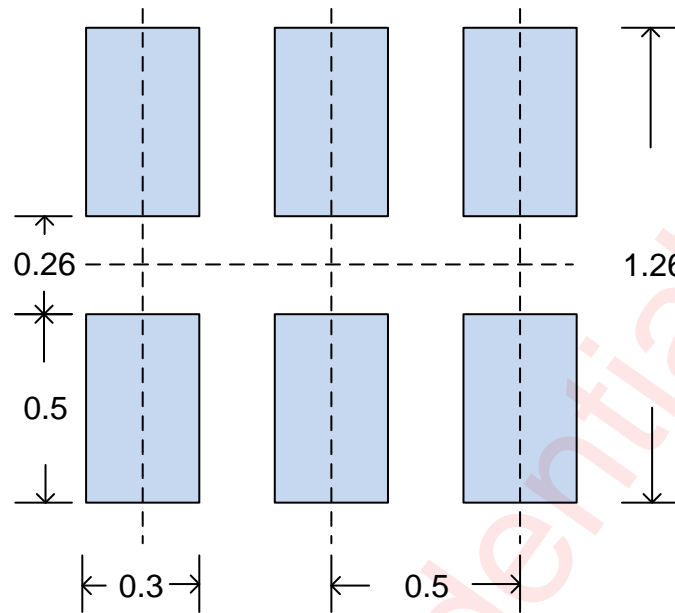
- 1、 ALL DIMS IN mm;
- 2、 General Tolerance  $\pm 0.25$ mm.

PACKAGE INFORMATION



SYMBOL	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	0.500	0.600	0.020	0.024
A1	0.000	0.050	0.000	0.002
A3	0.152REF.		0.006REF.	
b	0.150	0.250	0.006	0.010
b1	0.150REF.		0.006REF.	
D	0.900	1.100	0.035	0.043
E	1.400	1.600	0.055	0.063
e	0.500BSC.		0.020BSC.	
k	0.300REF.		0.012REF.	
k1	0.250REF.		0.010REF.	
L	0.300	0.400	0.012	0.016
L1	0.350	0.450	0.014	0.018

## LAND PATTERN EXAMPLE



NOTE: Dimensions are in millimeters.

## REFLOW

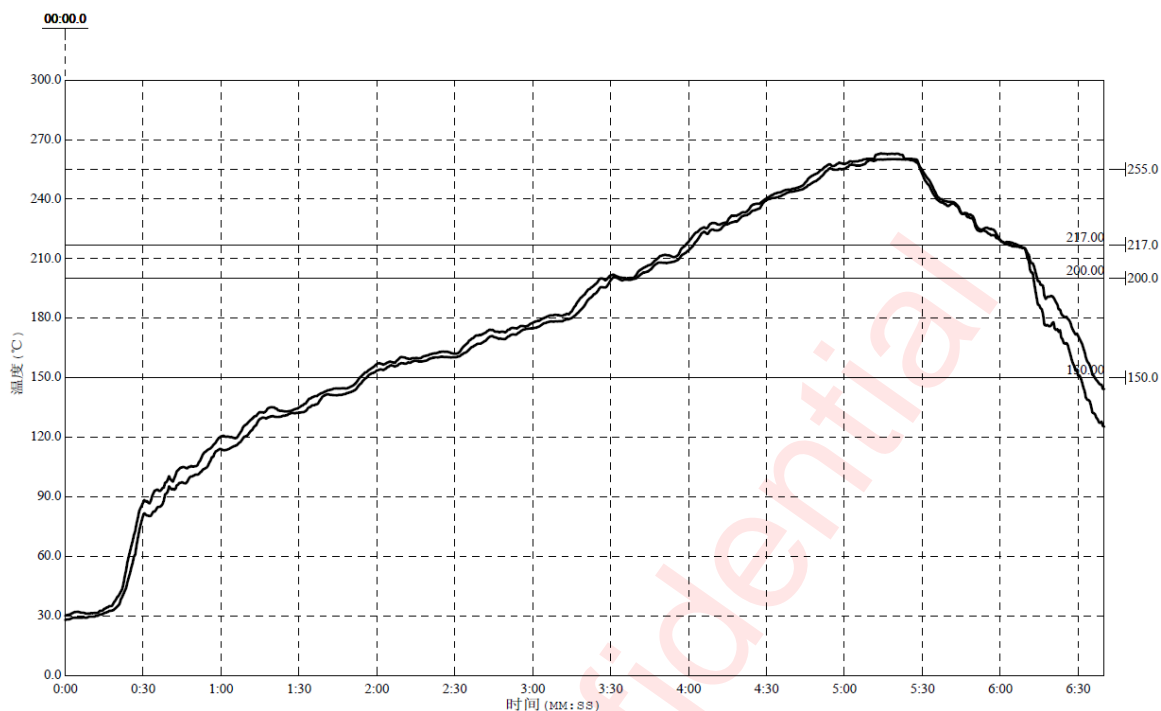


Figure 3 Package Reflow Oven Thermal Profile

Reflow Note	Spec
Average ramp-up rate (217°C to Peak)	Max. 3°C/sec
Time of Preheat temp.(from 150°C to 200°C)	60-120sec
Time to be maintained above 217°C	60-150sec
Peak Temperature	250°C-260°C
Time within 5°C of actual peak temp	20-40sec.
Ramp-down rate	Max. 6°C/sec
Time from 25°C to peak temp	Max. 8min.

## REVISION HISTORY

Vision	Date	Change Record
V0.9	July 2016	Datasheet V0.9 Released
V1.0	October 2016	Datasheet V1.0 Released
V1.1	January 2017	1. Added Tape and Reel information; 2. Added RoHS and MSL statements. 3. Added Land pattern example.
V1.2	February 2018	1. Updated Ordering Information table; 2. Deleted Page1 Chinese content.
V1.3	September 2018	1. Updated MSL level.

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