FEELING
TECHNOLOGY

FD036KT
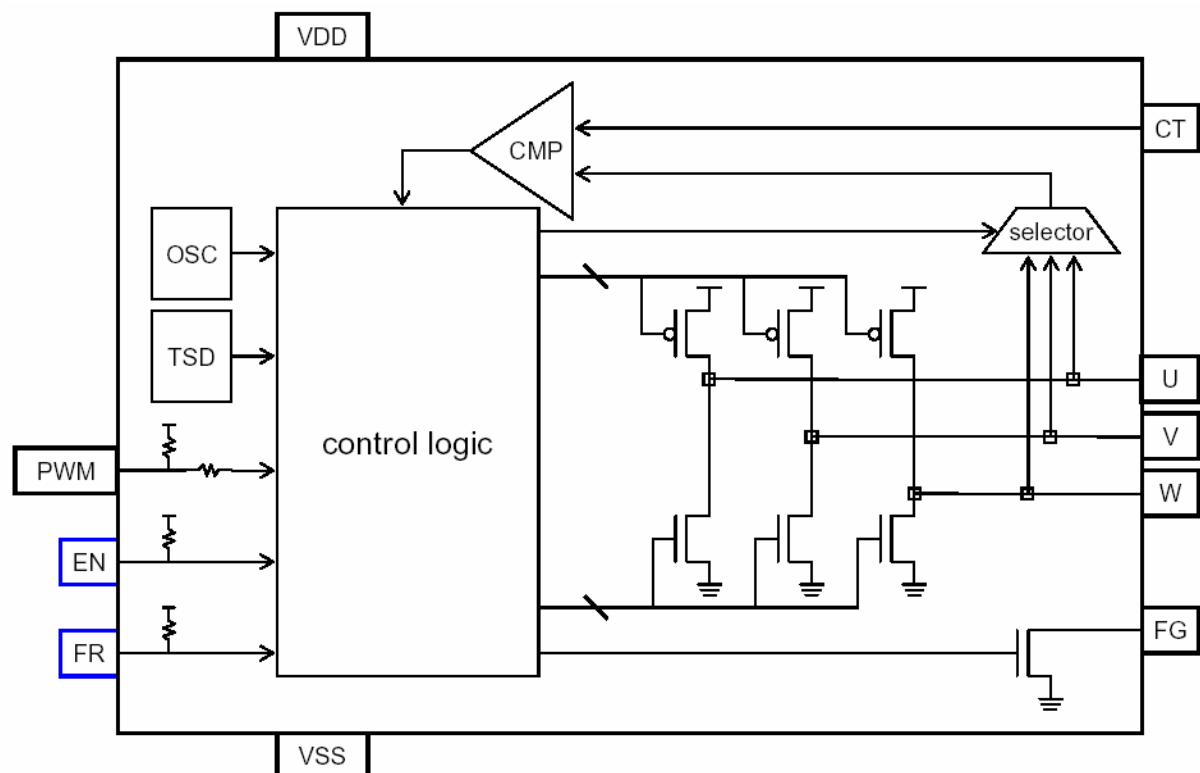FD036UT

Sensorless 3-phase brushless DC Motor driver

Features
- PWM (pulse width modulation) speed control
- Built-in FG(frequency generation) for rotation speed calculation, or RD(rotation detection) signal output for rotation status monitoringSoft-switching technique to reduce vibration and acoustic noise
- Thermal shutdown protection
- Lock protection and auto-restart function
- Selectable direction of rotation(FD036UT)
- Low stand-by current in Disable mode(FD036UT)

General Description
FD036 is a sensorless 3-phase brushless DC motor driver. It senses the BEMF(Back-ElectroMotive Force) of the motor in rotation and provides corresponding commutation current to the motor. The use of sensorless technology means no Hall sensors are needed. The absence of the Hall-sensor makes the fabrication of the motor easier and is especially suitable for ultra-small motors since the motor driver IC is placed outside the motor assembly.
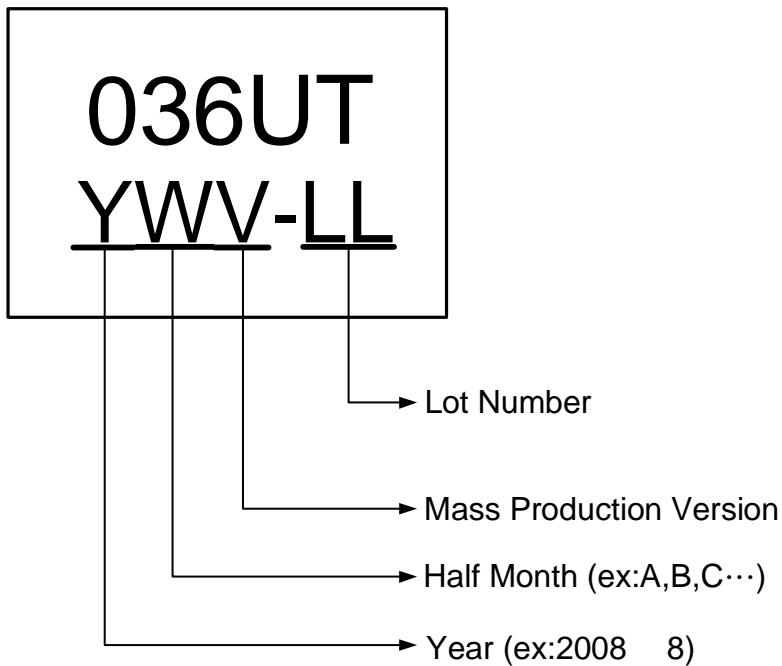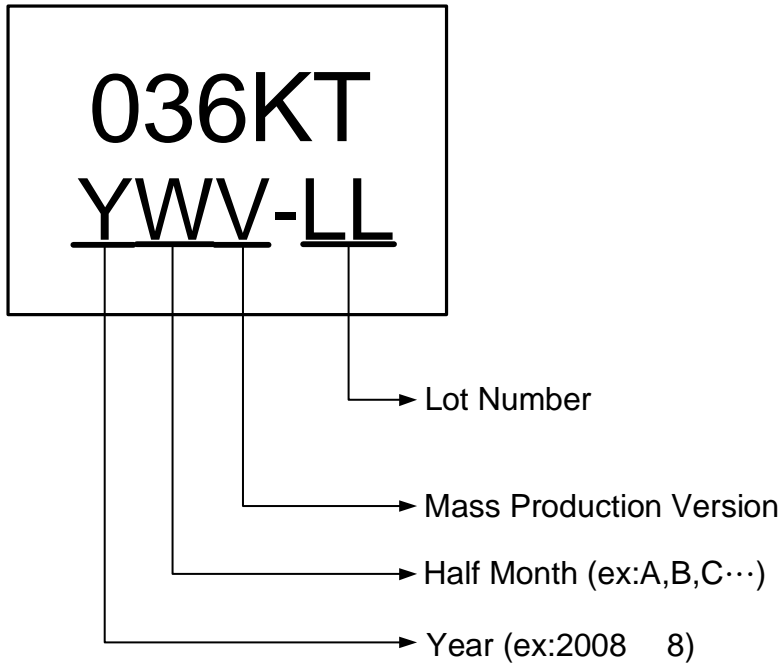
Block Diagram

Fig.1

Pin Connection
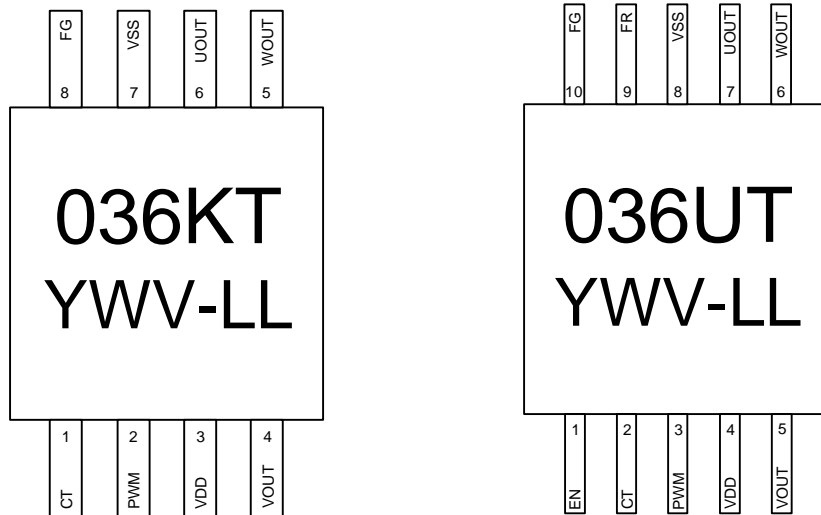
Fig.2

Pin Descriptions

Name	I/O	FD036KT	FD036UT	Description
VDD	P	3	4	Positive supply
VSS	G	7	8	Ground
EN	I	-	1	Enable, High active
UOUT	O	6	7	Driver output
VOUT	O	4	5	Driver output
WOUT	O	5	6	Driver output
CT	I	1	2	Center tap voltage input
FG	O	8	10	Frequency generation
PWM	I	2	3	Pulse width modulation input for speed control
FR	I	-	9	Forward/Reverse rotation direction selection

Legend: I=input, O=output, I/O=input/output, P=power supply, G=ground

Marking Distinguish

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┌─────────────────┐
│                 │
│    036KT        │
│    YWV-LL       │
│                 │
└─────────────────┘
```

→ Lot Number

→ Mass Production Version

→ Half Month (ex:A,B,C···)

→ Year (ex:2008　8)

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│                 │
│    036UT        │
│    YWV-LL       │
│                 │
└─────────────────┘
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→ Lot Number

→ Mass Production Version

→ Half Month (ex:A,B,C···)

→ Year (ex:2008　8)

Functional Descriptions

● PWM

PWM(pulse-width modulation) is used for the speed control for FD036. 2 types of PWM input signals can be used :

1. Voltage mode PWM :

Applying a constant(DC) voltage to the PWM pin and the FD036 will generate PWM pulses internally with the "ON" H/(L+H) duty cycle ratio according to the diagram below(Fig.4), which can be utilized by the user to control the speed of the motor. The rotation speed will be higher if the voltage applied to the PWM pin is higher.
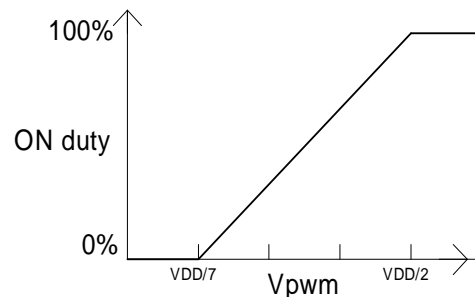
Fig.4

2. Pulse mode PWM :

User can also apply PWM pulses directly to the PWM pin. The FD036 will pass this pulse to the coil driver with the original duty-cycle ratio. The rotation speed will be higher with a higher H/(L+H) ratio.

Note:

(1) While using pulse mode PWM, the "High" Value of the input pulse should be higher than VDD/2 and the "Low" value should be lower than VDD/7

(2) The lower-limit for the PWM pulse frequency is 200Hz, and the recommended frequency range is in the range of 25KHz~30KHz where the PWM input pulse does not generate additional acoustic noise.

(3) The "PWM" pin contains an internal pull-up resistor so the FD036 will rotate in full-speed(100% ON) when this pin is left un-connected(floating).

● Soft-switching

FD036 uses the "soft-switching" technique to reduce the vibration and acoustic noise during rotation.

● Direction of rotation

The direction of rotation can be selected by the setting the input voltage of "FR" to VDD(Forward) or VSS(Reverse). The "FR" pin contains an internal pull-up resistor so the FD036 will rotate in the "Forward" direction when this pin is left un-connected(floating).

● Protection strategies for the coil driver

1. Thermal Shutdown

FD036 will shutdown the driver when the IC temperature rises beyond 165°C. It would release the shutdown condition when the temperature drops below 140°C.

2. Lock protection and auto-restart function

FD036 will shutdown the driver when the rotor is blocked for a short period of time, which keeps the coil from over-heated. It will try to restart the motor after the shutdown interval.

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Absolute Maximum Ratings

Parameter	Symbol	Conditions	Values			Unit
			min.	Typ.	max.	
Operating Temperature	T_{OP}	-	-20		85	℃
Storage Temperature	T_{ST}	-	-40		150	℃
DC Supply Voltage	V_{DD}	-	-0.3		6.5	V
Supply Current	I_{DD}	-			6	mA
Continuous Current	$I_{O(CONT)}$				500	mA
Hold Current	$I_{O(HOLD)}$				800	mA
PWM voltage range	V_{PWM_H}		>0.5VDD		6.5	V
	V_{PWM_L}		0		<0.14VDD	V
FG sink current	I_{FG_SINK}				25	mA
Junction temperature	T_J				150	℃
Power Dissipation	P_D	MSOP8			400	mW
		MSOP10			420	mW
Magnetic Flux Density	B				Unlimited	Gauss
IR-Reflow Lead Temperature		10sec			260	℃
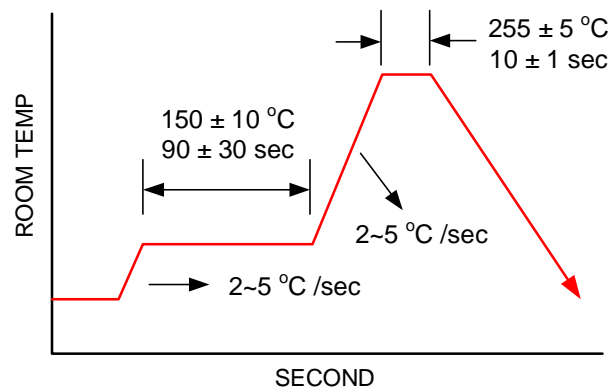
IR-ReFlow Soldering Condition

Recommended Operating Conditions

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Supply Voltage	V_{DD}	-	2.2		6.5	V
Operating Temperature Range	T_A	-	-20		85	℃

Electrical Characteristics V_{DD}=5.0V, T_A=25℃ (unless otherwise specified)

Parameter	Symbol	Conditions	Values			Unit
			min.	typ.	max.	
Average Supply Current(no load)	I_{DD}			5		mA
Output Saturation Voltage(FG)	V_{SAT_FG}	V_{DD}=5V, T_A=25 ℃, Iout=10mA		0.3		V
Output leakage current(FG)	$I_{LEAKAGE\_FG}$	V_{OUT}=5V			1	µA
On resistance(Rpmos+Rnmos)	R_{ON}			2		Ω
Thermal Shutdown Threshold	$T_{THERMAL}$			165		℃

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Application Circuit Reference

FD036KT

2.2uF

4.7Ohms

FD036UT

2.2uF

4.7Ohms
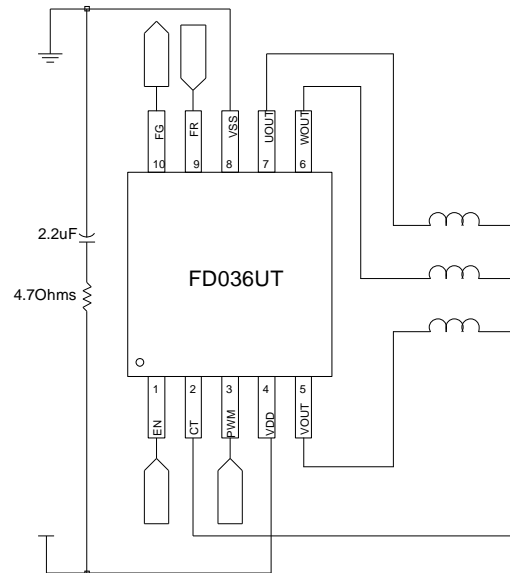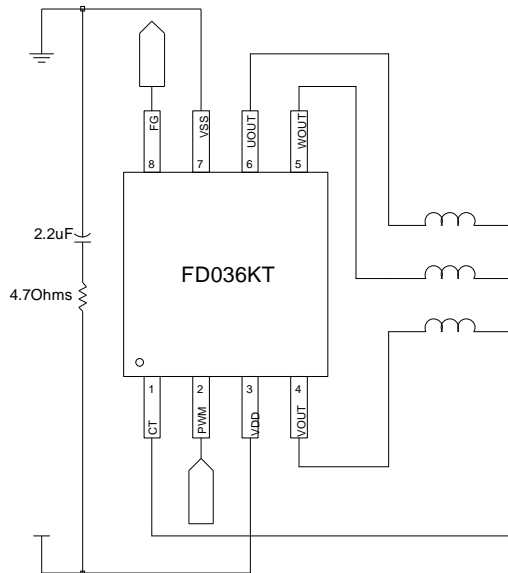
Note : Please place the decoupling capacitor as close to the IC as possible

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Package Outline
MSOP-8L
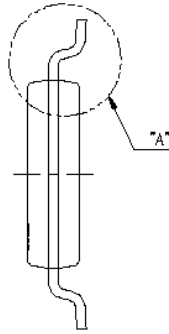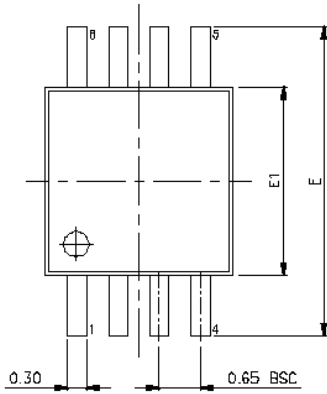
SYMBOLS	MIN.	NOM.	MAX.
A	—	—	1.10
A1	0.00	—	0.15
A2	0.75	0.85	0.95
D	3.00 BSC		
E	4.90 BSC		
E1	3.00 BSC		
L	0.40	0.60	0.80
L1	0.95 REF		
θ°	0	—	8

UNIT : MM

DETAIL A
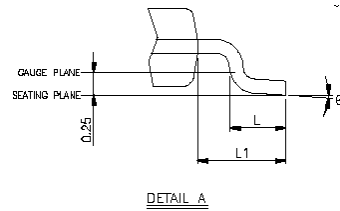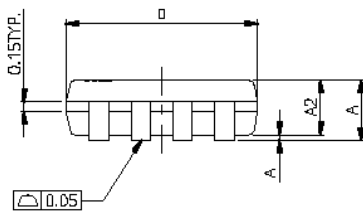
MSOP-10L
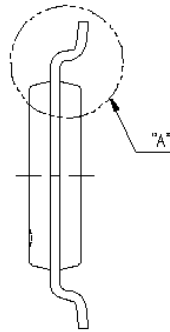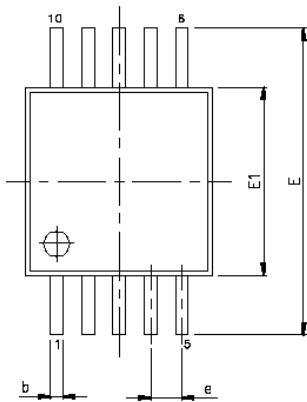
SYMBOLS	MIN.	NOM.	MAX.
A	—	—	1.10
A1	0.00	—	0.15
A2	0.75	0.85	0.95
b	0.17	—	0.27
c	0.08	—	0.23
D	3.00 BSC		
E	4.90 BSC		
E1	3.00 BSC		
e	0.50 BSC		
L	0.40	0.60	0.80
L1	0.95 REF		
θ°	0	—	8

UNIT : MM

DETAIL A
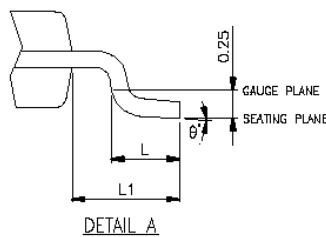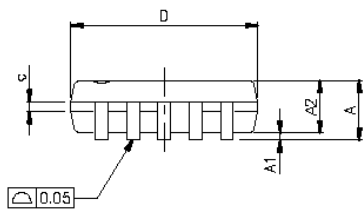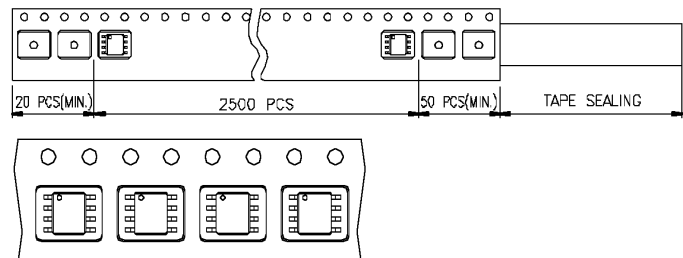
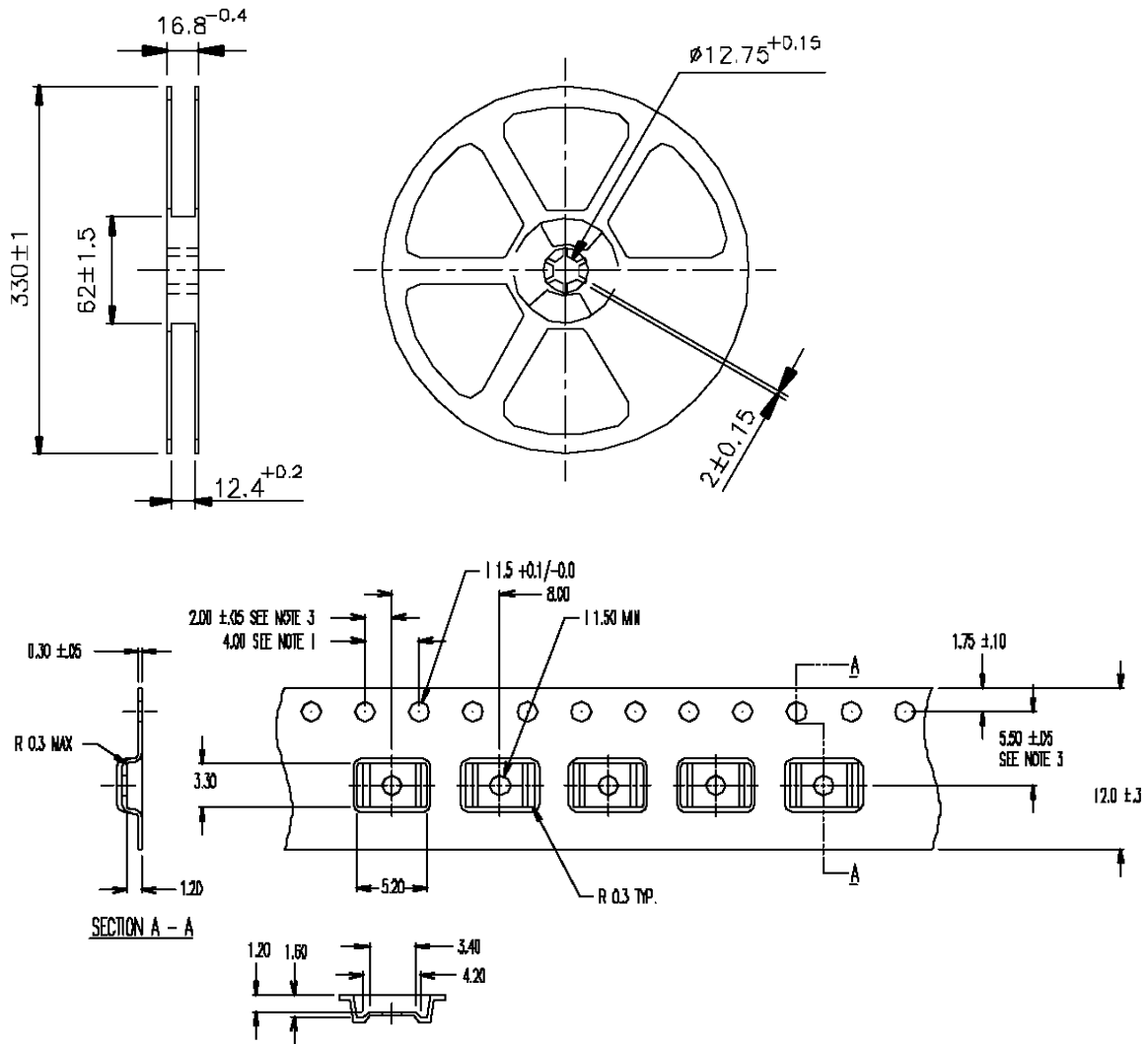## Packing Specification
(Tapping Reel) <u>MSOP8</u>
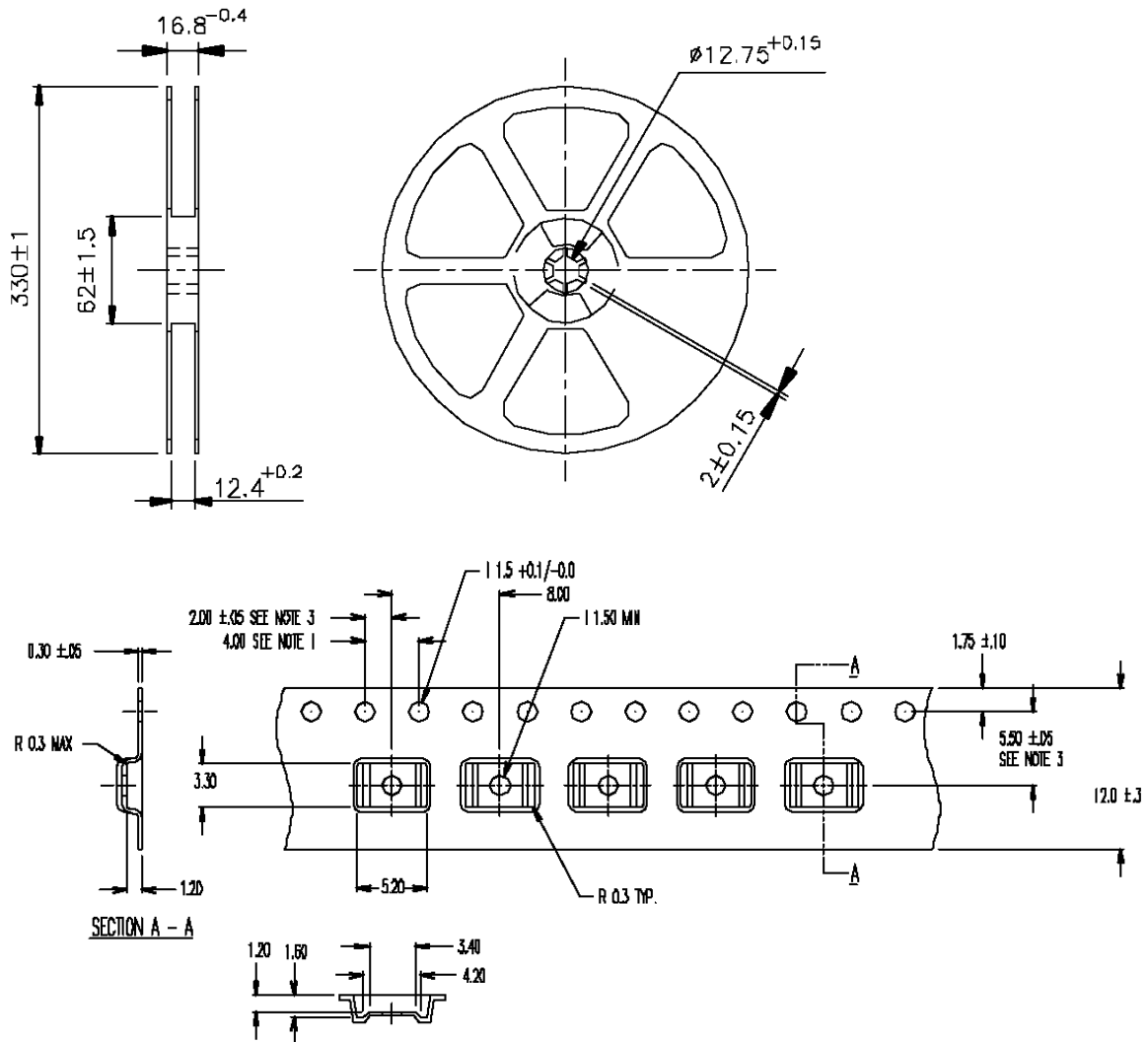
NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED AS TRUE POSITION OF POCKET, NOT POCKET HOLE

Packing Quantity Specifications

2500 EA / REEL

1 TAPE REEL / 1 INSIDE BOX

4 INSIDE BOXES / 1 CARTON

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**Packing Specification
(Tapping Reel) MSOP10**

NOTES:
1. 10 SPROCKET HOLE PITCH CUMULATIVE TOLERANCE ±0.2
2. CAMBER IN COMPLIANCE WITH EIA 481
3. POCKET POSITION RELATIVE TO SPROCKET HOLE MEASURED
   AS TRUE POSITION OF POCKET, NOT POCKET HOLE
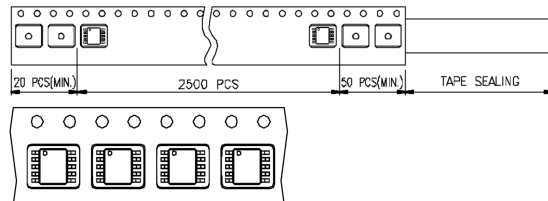
Packing Quantity Specifications

2500 EA / REEL

1 TAPE REEL / 1 INSIDE BOX

4 INSIDE BOXES / 1 CARTON

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Order Information

Part Number	Operating Temperature	Package
FD036KT	-20 ^{o}C to +85 ^{o}C	MSOP8
FD036UT	-20 ^{o}C to +85 ^{o}C	MSOP10