**MAXINMICRO**
ELECTRONICS

# GENERAL DESCRIPTION

The MX5114E is designed to drive a VCSEL with strong sink current capability from an internal N-MOSFET. The MX5114E provides inverting and noninverting inputs to satisfy requirements for inverting and noninverting input. The inputs of the MX5114E are TTL/CMOS Logic compatible and withstand input voltages up to 18 V regardless of the VDD voltage. The MX5114E has fast switching speed and minimized propagation delays, facilitating high-frequency operation. The MX5114E is available in a 6-pin SOT23-6 package.

# FEATURES

♦ 4V to 20V Single Power Supply

♦ 15A Peak Current Transient

♦ 0.4Ω turn on resistance with internal FET

♦ 5ns (Typical) Propagation Delay

♦ Matching Delay Time Between Inverting and Noninverting Inputs

♦ TTL/CMOS Logic Inputs

♦ Low Input Capacitance: 2.5pF (Typical)

♦ –40°C to 125°C Operating Temperature Range

♦ 6-Pin SOT23-6L

# APPLICATIONS

Laser driver without external MOSFET

# TYPICAL APPLICATION
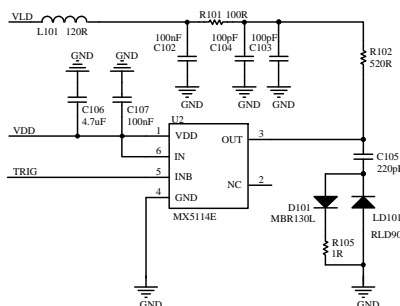
# GENERAL INFORMATION

## Ordering information

| Part Number | Description |
|---|---|
| MX5114E | SOT23-6L |
| MPQ | 3000pcs |

## Package dissipation rating

| Package | RθJA（℃/W） |
|---|---|
| SOT-23 (6) | 108.1 |

## Absolute maximum ratings

| Parameter | Value |
|---|---|
| VDD to GND | -0.3 to 24V |
| IN, INB to GND | -0.3 to 24V |
| OUT to GND | -0.3 to VDD+0.3V |
| Junction temperature | 150℃ |
| Storage temperature, Tstg | -55 to 150℃ |
| Leading temperature （soldering，10secs） | 260℃ |
| ESD Susceptibility HBM | ±2000V |

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.
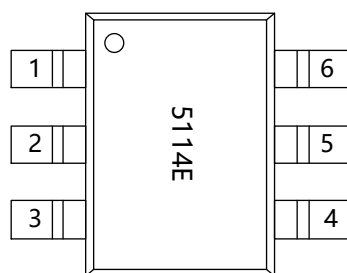
## Marking information



Maxin Micro — MX 5114E — Part number
Pin 1 — YYWWA — Internal code
Year code — Week code
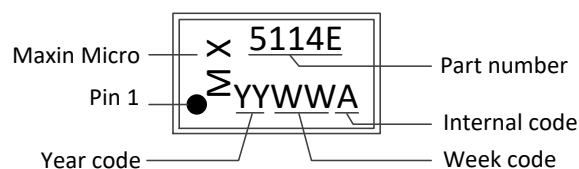
## Recommended operating condition

| Symbol | Parameter | Range |
|---|---|---|
| VDD | VDD supply voltage | 4-20V |
| Junction temperature | | -40~125°C |
| PD | Power dissipation | 0.59W |
| Moisture sensitive level | | MSL3 |

# TERMINAL ASSIGMENTS



Pin information

| PIN NO. | PIN name | Description |
|---|---|---|
| 1 | VDD | Gate drive supply<br>Locally decouple to GND using low ESR/ESL capacitor located as close as possible to the IC. |
| 2 | NC | No connection. |
| 3 | OUT | Open drain of internal FET output pin. |
| 4 | GND | Ground<br>All signals are referenced to this ground. |
| 5 | INB | Inverting logic input<br>Connect to GND when not used. |
| 6 | IN | Noninverting logic input Connect to VDD when not used. |

# BLOCK DIAGRAM
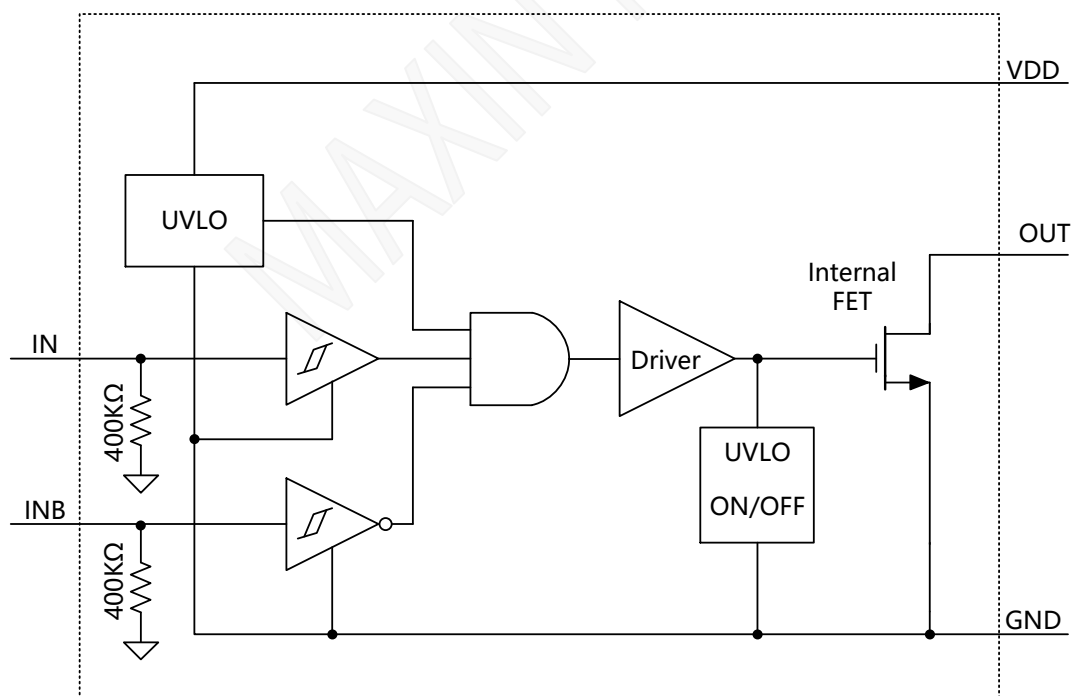
## Electrical characteristics

（ TA=25℃，VDD=12V, unless otherwise noted）

| Symbol | Parameter | Test condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| POWER SUPPLY | | | | | | |
| $I_{DD}$ | Supply current，VDD=12V | VDD=IN=12V，INB=100kHz | | 70 | 300 | μA |
| IQ | Quiescent current | VDD=12V | | 45 | 250 | μA |
| IQ_IN_H | Quiescent current | VDD=IN=12V | | 45 | 250 | μA |
| IQ_INB_L | Quiescent current | VDD=12, INB=0 | | 45 | 250 | μA |
| $I_{DD\_OFF}$ | VDD=3.0V，IN=GND，INB=VDD | | | 20 | 50 | μA |
| | VDD=3.0V，IN=VDD，INB=GND | | | 30 | 60 | μA |
| $U_{VLO\_ON}$ | UVLO rising threshold | VDD rising | 3.1 | 3.3 | 3.5 | V |
| $U_{VLO\_OFF}$ | UVLO falling threshold | VDD falling | 3.5 | 3.85 | 4.2 | V |
| $U_{VLO\_HYS}$ | UVLO threshold hysteresis | | 0.2 | 0.5 | 0.8 | V |
| LOGIC INPUT | | | | | | |
| $V_{IN\_H}$ | Noninverting input high voltage | IN input rising | 1.8 | 2.1 | 2.4 | V |
| $V_{IN\_L}$ | Noninverting input low voltage | IN input falling | 0.9 | 1.2 | 1.5 | V |
| $V_{INB\_H}$ | Inverting input high voltage | INB input rising | 1.8 | 2.1 | 2.4 | V |
| $V_{INB\_L}$ | Inverting input low voltage | INB input falling | 0.9 | 1.2 | 1.5 | V |
| $R_{INBL}$ | Inverting input pull down resistor | | | 400 | | kΩ |
| $R_{INL}$ | Noninverting input pull down resistor | | | 400 | | kΩ |
| N-CHANNEL OUTPUT | | | | | | |
| $R_{ON}$ | Output resistance-pulling down @ 4.5V | VDD=4.5V, IIN_OUT=-50mA | | 0.60 | 0.85 | Ω |
| | Output resistance-pulling down @ 10V | VDD=10V, IIN_OUT=-50mA | | 0.40 | 0.65 | Ω |
| $I_{PK}$ | Peak current | Turn on 50ns and Turn off 30μs | | 15 | | A |
| $I_{PKIN}$ | Internal FET drive capability | | | 7.6A | | A |
| SWITCHING CHARACTERISTICS | | | | | | |
| $C_{IN}$ | Input capacitance | | | 2.5 | | pF |
| $T_{FALL}$ | Fall time | VDD=12V，No capacitor | | 2 | 5 | ns |
| $T_{DLH}$ | Propagation delay, Low to High, noninverting | | | 5 | 10 | ns |
| $T_{DHL}$ | Propagation delay, High to Low, noninverting | | | 5 | 10 | ns |
| $T_{DHH}$ | Propagation delay, High to High, inverting | | | 5 | 10 | ns |
| $T_{DLL}$ | Propagation delay, Low to Low, inverting | | | 6 | 10 | ns |
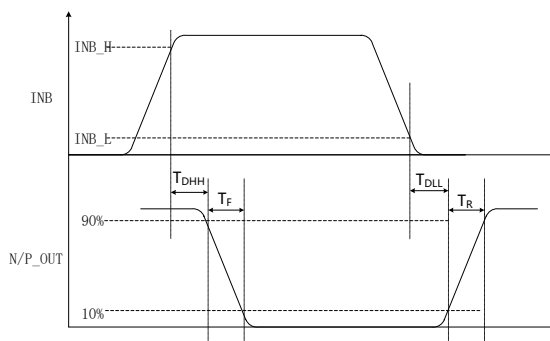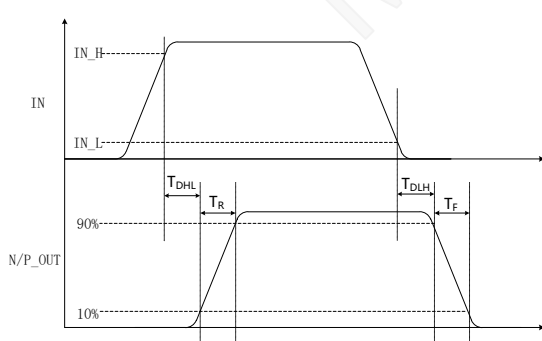


Note：OUT is tied to VDD from a small resistor

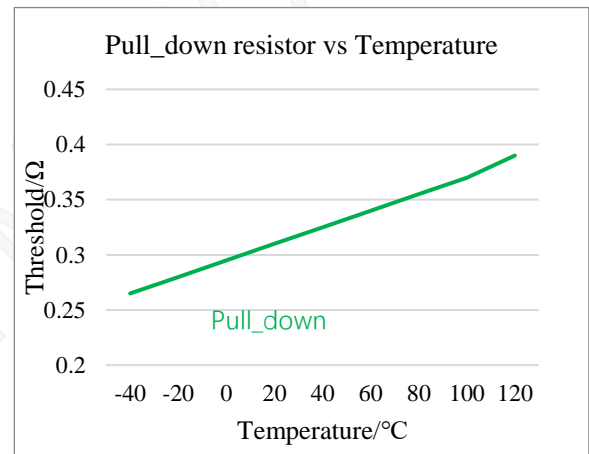# Characteristic plots

IDD_OFF vs temperature
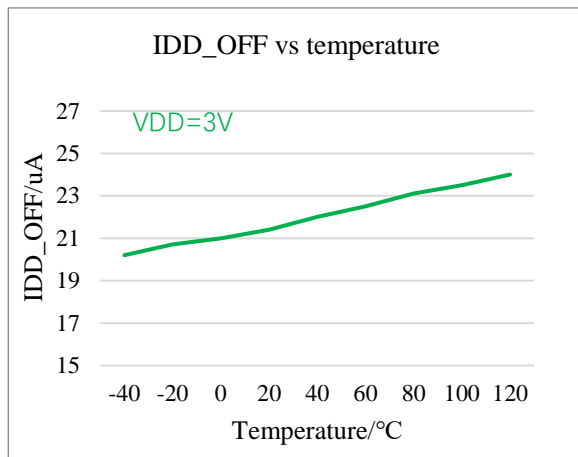
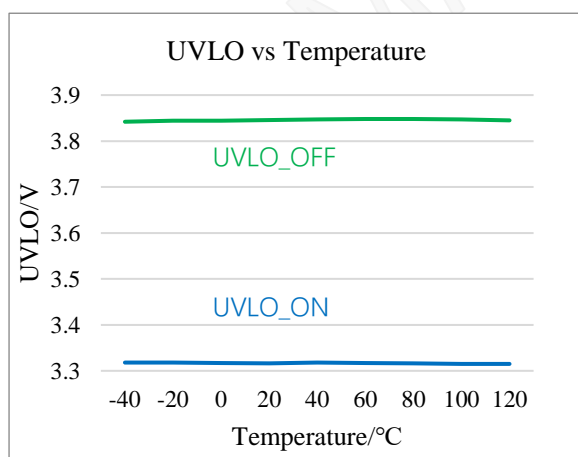VDD OFF current vs temperature
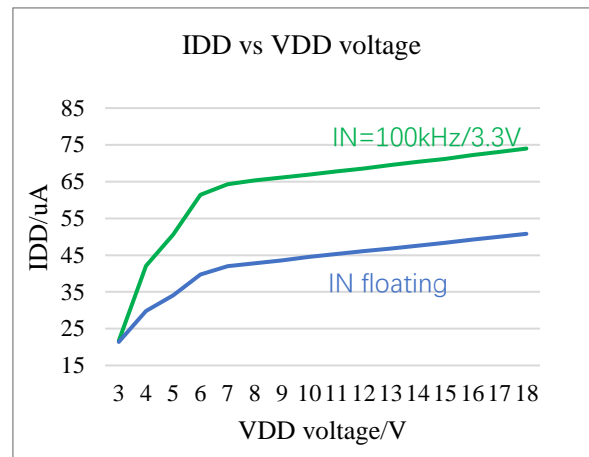
IDD vs VDD voltage

Operation current vs VDD voltage

falling and falling delay time vs VDD voltage

Falling and falling delay time vs VDD voltage
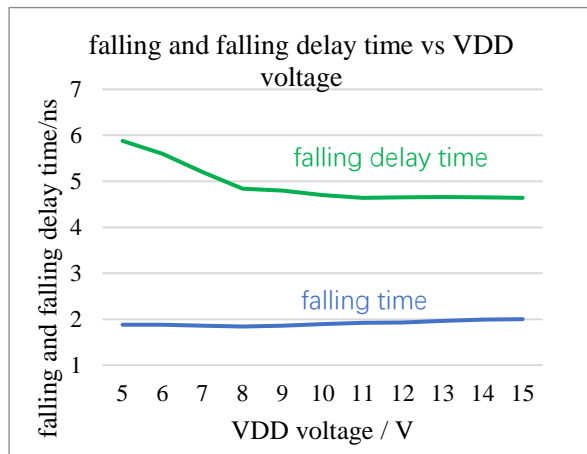
Pull_down resistor vs Temperature

Pull up and pull down resistor vs temperature

UVLO vs Temperature

UVLO vs temperature

Threshold vs Temperature
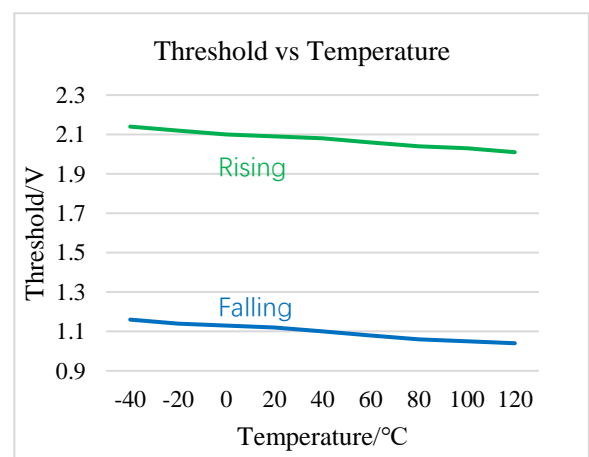
IN and INB high and low threshold vs temperature

# Operation description

The MX5114E is a special purpose circuit for laser driver with 15A peak current capability. Inputs of the MX5114E are CMOS/TTL Logic compatible and can withstand the input voltages up to 18V regardless of the VDD voltage. This allows inputs of the MX5114E to be connected directly to most PWM controllers.

The MX5114E startup logic is optimized to drive ground-referenced N channel FET with an under voltage lockout function to ensure that the IC starts up in an orderly fashion. When VDD is rising, yet below the UVLO level, this circuit holds the output LOW, regardless of the status of the input pins. After the part is active, the supply voltage must drop 0.5V before the part shuts down. This hysteresis helps prevent chatter when low VDD supply voltages have noise from the power switching.

### VDD bypass capacitor guidelines

To enable this IC to turn a device on quickly, a local high frequency bypass capacitor, with low ESR and ESL should be connected between the VDD and GND pins with minimal trace length. This capacitor is in addition to the bulk electrolytic capacitance of 10uF to 47uF commonly found on the driver and controller bias circuits.

A typical criterion for choosing the value of bypass capacitor is to keep the ripple voltage on the VDD supply to ≤5%. This is often achieved with a value ≥20 times the equivalent load capacitance, defined here as QG/VDD. Ceramic capacitors of 0.1uF to 1uF or larger are common choices, as are dielectrics, such as X5R and X7R with good temperature characteristics and high pulse current capability.

### Peak current test

The peak current test is as shown in the figure below, the pulse width is 50ns and the period is 30us. And the test result shown in the second figure. The peak current can be calculated as $IPK=1.47V/0.1R=14.7A$.
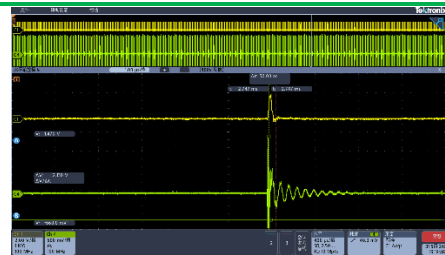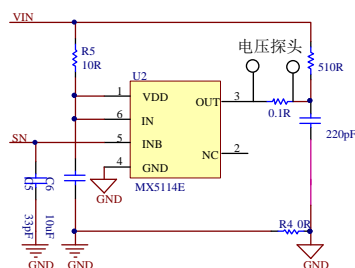


### Layout and connection guidelines

The MX5114E family of ToF drivers incorporates fast-reacting input circuits, shortage propagation delays, and powerful output stages capable of delivering current peaks over 15A to facilitate voltage transition times from under 5ns to over 50ns. The following layout and connection guidelines are strongly recommended:

● Keep high current output and power ground paths separate logic and enable input signals and signal ground paths. This is especially critical when dealing with TTL-level logic thresholds at driver inputs pins.

● In noisy environments, it may be necessary to tie inputs of an unused PIN to VDD or GND using short traces to prevent noise from causing spurious output switching.

● Many high speed power circuits can be susceptible to noise injected from their own output or other external sources, possibly causing output re-triggering. These effects can be obvious if the circuit is tested in breadboarding or non-optimal circuit layouts with long IN, INB, or OUT, leads. For best results, make connections to all pins as short and direct as possible.

● The MX5114E is compatible with many other industry standard drivers. In single input pin IN, there is an internal resistor tied to GND and INB tied to VDD, this should be considered in the PCB layout.

### Truth table of logic operation

The MX5114E truth table indicates the operational states using the IN and INB input configuration. MX5114E can be used in laser distance test, and only INB and OUT can be used without external NMOSFET. And at this time, the IN should be connected to VDD pin.

| IN | INB | OUT |
|----|-----|-----|
| H | H | L |
| H | L | Open circuit |
| L | L | L |
| L | H | L |

## Package information
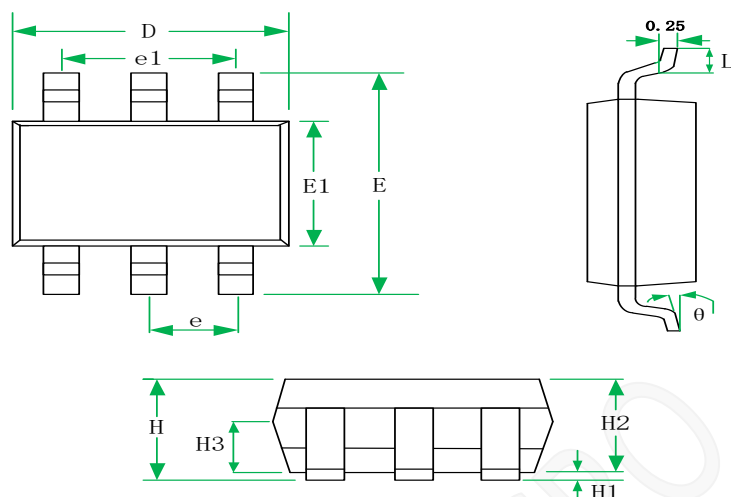


| SYMBOL | MILLIMETERS | | | INCHES | | |
|---|---|---|---|---|---|---|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| H | 1.070 | 1.160 | 1.250 | 0.042 | 0.046 | 0.049 |
| H1 | 0.020 | 0.060 | 0.100 | 0.001 | 0.002 | 0.004 |
| H2 | 1.050 | 1.100 | 1.150 | 0.041 | 0.043 | 0.045 |
| H3 | 0.600 | 0.650 | 0.700 | 0.024 | 0.026 | 0.028 |
| D | 2.820 | 2.920 | 3.020 | 0.111 | 0.115 | 0.119 |
| E | 2.60 | 2.80 | 3.00 | 0.102 | 0.110 | 0.118 |
| E1 | 1.40 | 1.60 | 1.80 | 0.055 | 0.063 | 0.071 |
| e | 0.95BSC | | | 0.037BSC | | |
| e1 | 1.90BSC | | | 0.074BSC | | |
| L | 0.30 | | 0.60 | 0.012 | | 0.024 |
| θ | 0 | | 8° | 0 | | 8° |

SOT23-6 for MX5114E

# Tape and Reel Information (unit in mm)
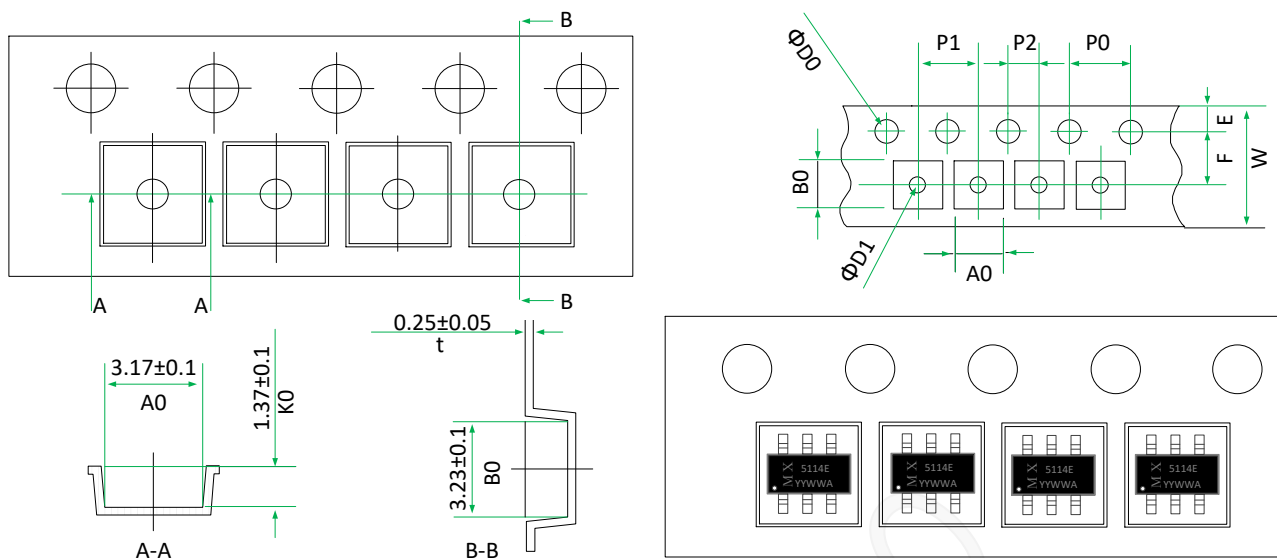


| Symbol | W | E | F | ΦD0 | ΦD1 | P0 | P1 | P2 | A0 | B0 | K0 | t |
|--------|------|------|------|------|------|------|------|------|------|------|------|------|
| MAX | 8.10 | 1.85 | 3.55 | 1.60 | 1.25 | 4.10 | 4.10 | 2.05 | 3.27 | 3.33 | 1.47 | 0.30 |
| MIN | 7.90 | 1.65 | 3.45 | 1.40 | 1.0 | 3.90 | 3.90 | 1.95 | 3.07 | 3.13 | 1.27 | 0.20 |



| Symbol | ΦA | ΦN | ΦB | C | W1 | W2 | W3 |
|--------|-----|-----|------|------|------|------|------|
| MAX | 180 | 56 | 13.5 | 2.50 | 9.9 | 12 | 1.8 |
| MIN | 176 | 52 | 13.0 | 1.90 | 8.4 | | 1.0 |
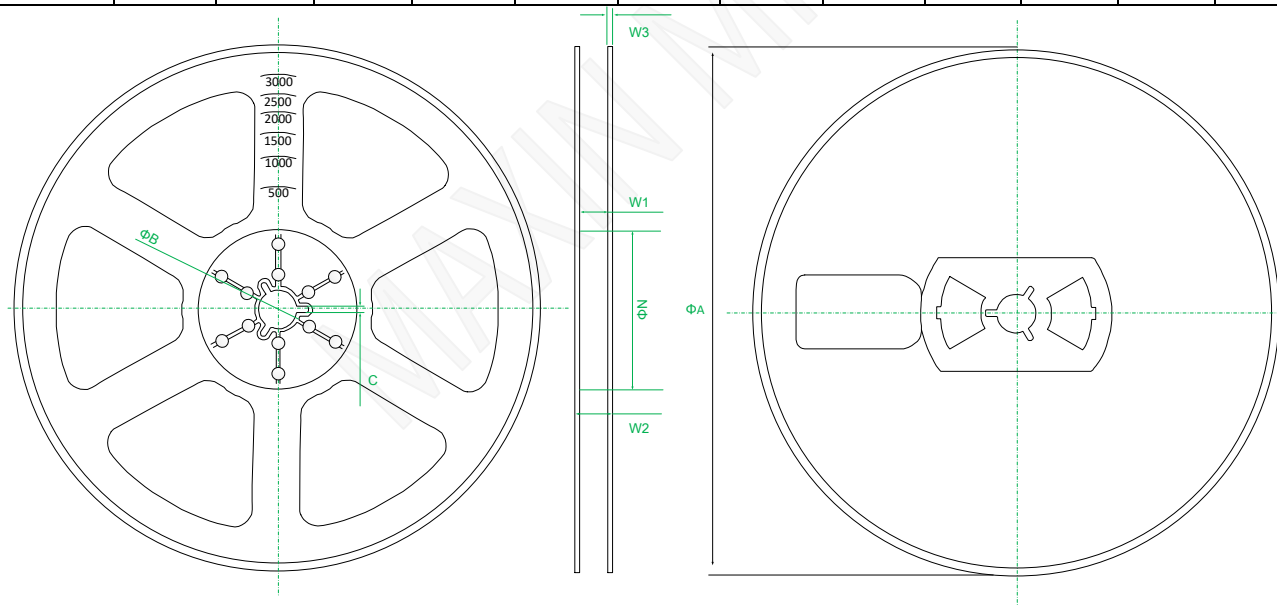
## Restrictions on Product Use

◆ MAXIN micro is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing MAXIN products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such MAXIN products could cause loss of human life, bodily injury or damage to property.

◆ In developing your designs, please ensure that MAXIN products are used within specified operating ranges as set forth in the most recent MAXIN products specifications.

◆ The information contained herein is subject to change without notice.

Version update record:

V10 The original version （preliminary）

V11 Add the peak current test waveform

V12 change the picture of typical application

V13 The INB internal pull up resistor change pull down resistor and the pull down resistor are added in block diagram

V14 add marking information and version information

V15 add tape and reel information and moisture sensitive level