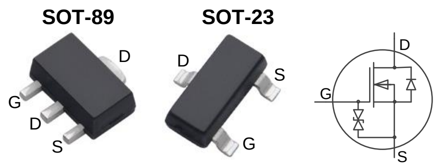
# Ultrahigh Threshold Voltage Depletion-Mode Power MOSFET

## General Features

- ESD Improved Capability
- Depletion Mode (Normally On)
- Proprietary Advanced Planar Technology
- Proprietary Advanced Ultrahigh Vth Technology
- RoHS Compliant
- Halogen-free Available




## Applications

- Quick Charger
- Current Source
- Voltage Source

## General Description

This novel depletion mode MOSFET, developed and manufactured by ARK proprietary ultrahigh threshold voltage technology. By using the sub threshold characteristics, the depletion mode MOSFET can provide stably power to the load, and the voltage can be clamped to protect the load without Zener diode, and the circuit consumption is reduced.

## Ordering Information

| Part Number | Package | Marking | Remark |
|---|---|---|---|
| DMZ1015E | SOT-23 | 1015 | Halogen Free |
| DMX1015E | SOT-89 | 1015 | Halogen Free |

## Absolute Maximum Ratings

$T_A$=25°C unless otherwise specified

| Symbol | Parameter | DMZ1015E | DMX1015E | Unit |
|---|---|---|---|---|
| $V_{DSX}$ | Drain-to-Source Voltage[1] | 100 | | V |
| $I_D$ | Continuous Drain Current | 0.1 | | A |
| $I_{DM}$ | Pulsed Drain Current[2] | 0.4 | | |
| $P_D$ | Power Dissipation | 0.5 | 1.0 | W |
| $V_{GS}$ | Gate-to-Source Voltage | ±30 | | V |
| $V_{ESD}$ | Gate to Source ESD[3] | 700 | | V |
| | Source to Gate ESD[3] | 700 | | V |
| $T_L$ | Soldering Temperature<br>Distance of 1.6mm from case for 10 seconds | 300 | | °C |
| $T_J$ and $T_{STG}$ | Operating and Storage Temperature Range | -55 to 150 | | |

*Caution: Stresses greater than those listed in the "Absolute Maximum Ratings" may cause permanent damage to the device.*

## Thermal Characteristics

| Symbol | Parameter | DMZ1015E | DMX1015E | Unit |
|---|---|---|---|---|
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 250 | 125 | K/W |

# Electrical Characteristics

## OFF Characteristics

$T_A$ =25°C unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| $BV_{DSX}$ | Drain-to-Source Breakdown Voltage | 100 | -- | -- | V | $V_{GS}$=-30V, $I_D$=1mA |
| $I_{GSS}$ | Gate-to-Source Leakage Current | -- | -- | 20 | μA | $V_{GS}$=+30V, $V_{DS}$=0V |
| | | -- | -- | -20 | | $V_{GS}$=-30V, $V_{DS}$=0V |

## ON Characteristics

$T_A$ =25°C unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| $I_{DSS}$ | Saturated Drain-to-Source Current | 100 | -- | -- | mA | $V_{GS}$=0V, $V_{DS}$=25V |
| $R_{DS(ON)}$ | Static Drain-to-Source On-Resistance | -- | -- | 30 | Ω | $V_{GS}$=0V， $I_D$=100mA[4] |
| $V_{GS(OFF)}$ | Gate-to-Source Cut-off Voltage | -- | -- | -27 | V | $V_{DS}$=9V, $I_D$=8μA |
| $V_{CL}$ | Source-to-Gate Clamp Voltage | 11.5 | -- | -- | V | $V_{DS}$=9V, $I_D$=5mA |

## Source-Drain Diode Characteristics

$T_A$=25°C unless otherwise specified

| Symbol | Parameter | Min | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{SD}$ | Diode Forward Voltage | -- | -- | 1.2 | V | $I_{SD}$=100mA, $V_{GS}$=-30V |

NOTE：

[1] $T_J$=+25°C to +150°C
[2] Repetitive rating, pulse width limited by maximum junction temperature.
[3] The test is based on JEDEC EIA/JESD22-A114 (HBM).
[4] Pulse width≤380µs; duty cycle≤2%.

## Typical and highlight Characteristics

DMZ1015E/ DMX1015E is an ultra-high threshold voltage depletion mode MOS device. A stable output voltage source or current source is implemented by using the sub-threshold characteristics of the device. Its basic application is shown as Figure 1:

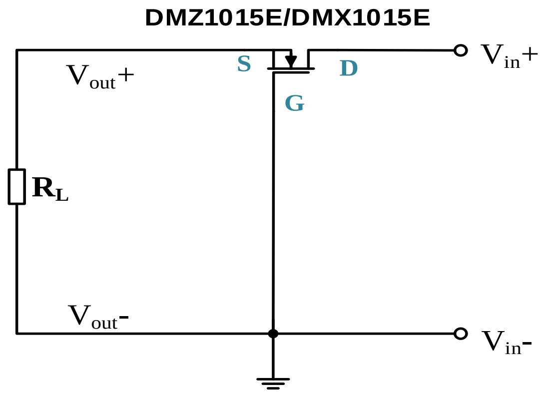
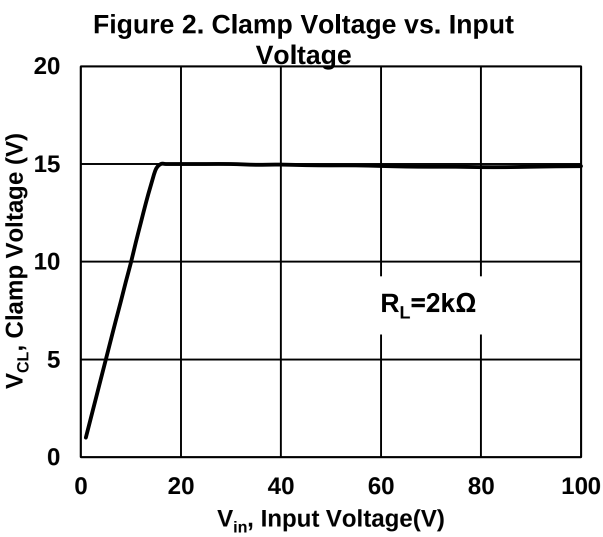
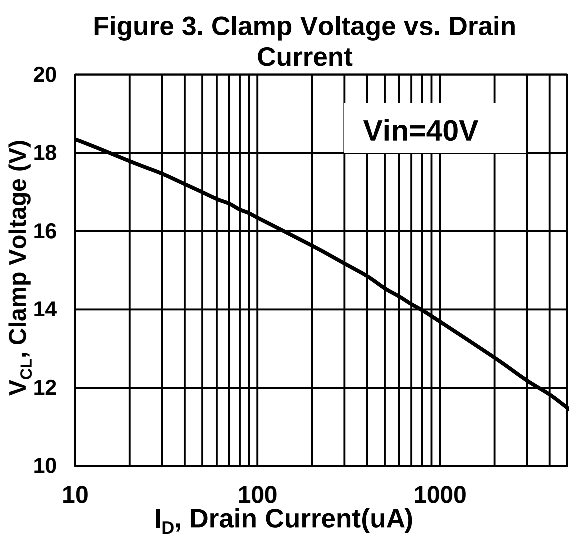
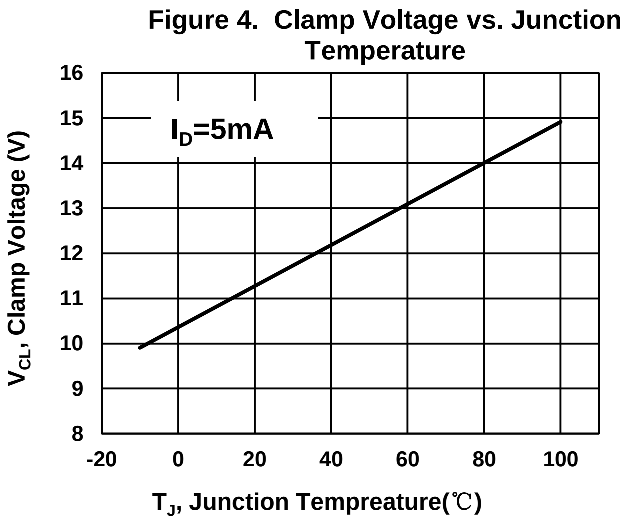



**Figure1. Drain Current $I_D$ is decided by Load Resistance**



## Typical Application

In the QC2.0/3.0 and Type-C/PD charger circuits, using DMZ1015E/DMX1015E as a high voltage linear regulagors can make the PWM IC power supply circuit more simplified, as shown below:

In Figure 5, the transistor Q is used to provide power, and the zener diode Z is used to clamp voltage, the power supply circuit of IC is composed of several components.

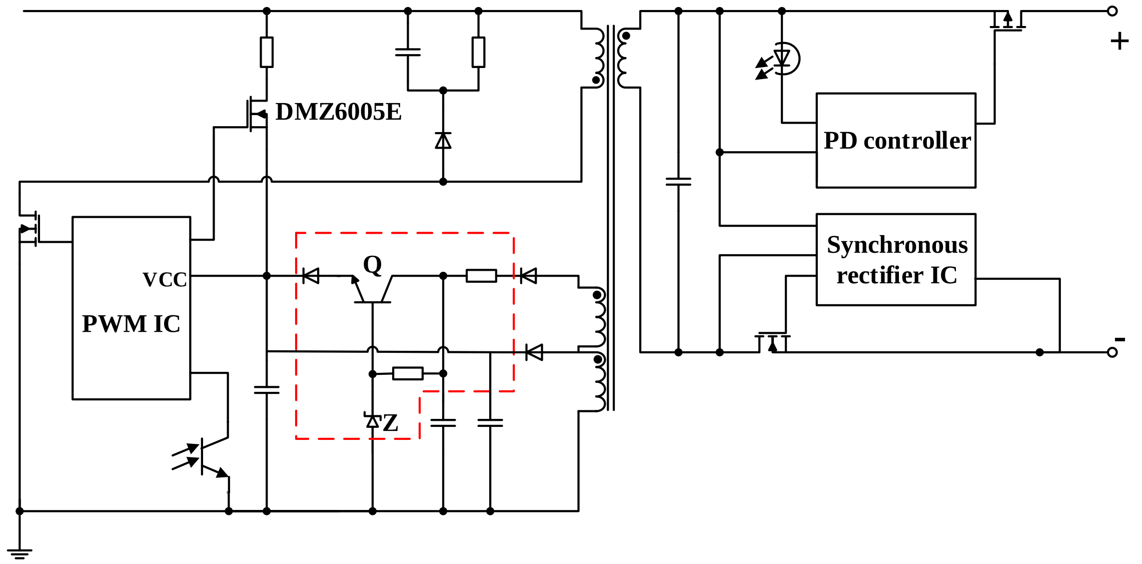



**Figure 5. Normal Circuit with Transistor and Diode**

In Figure 6, providing power and clamp voltage use only one device- DMZ1015E /DMX1015E, the circuit is simplified.

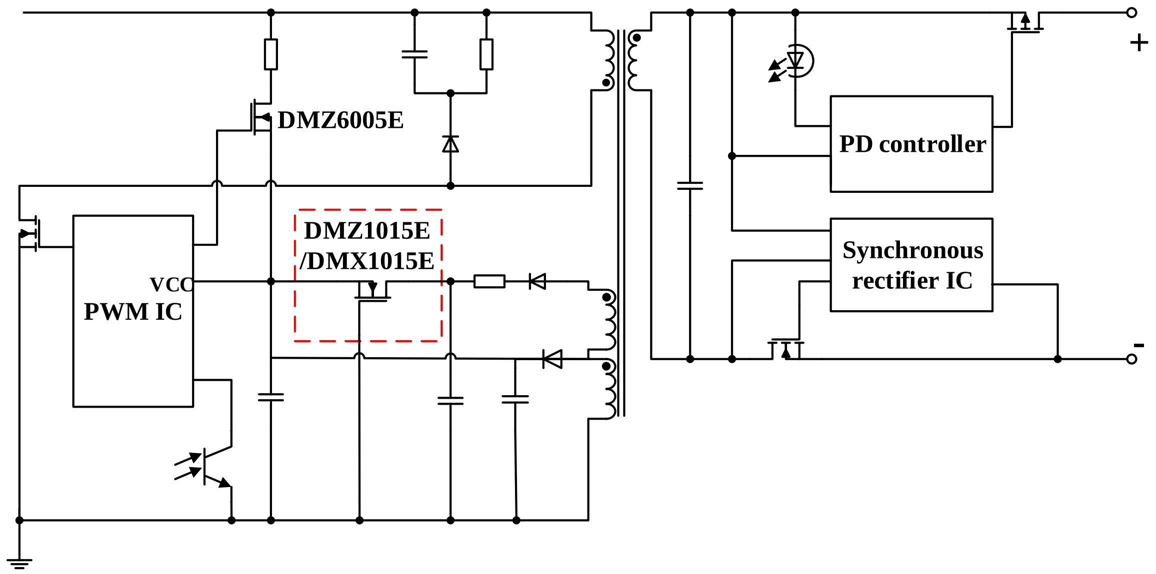


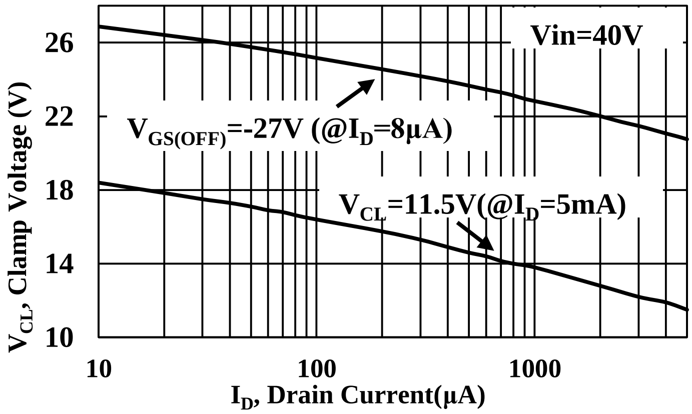

**Figure 6. Circuit with DMZ1015E/DMX1015E**

At room temperature and under 2~4mA working current (most IC's working current), the output voltage of DMZ1015E/DMX1015E is between 12~22V.

Due to strict design and process control,DMZ1015E/DMX1015E parameters have good consistency, but there are still some $V_{GS(OFF)}$ parameter distribution range, so we strictly control the final testing standard, the upper limit is $|V_{GS(OFF)}|$ =27V (under normal temperature $I_D$=8μA), the lower limit is $V_{CL}$=11.5V of clamping voltage ( under room temperature $I_D$ =5mA), so as to ensure under normal working condition and the working current

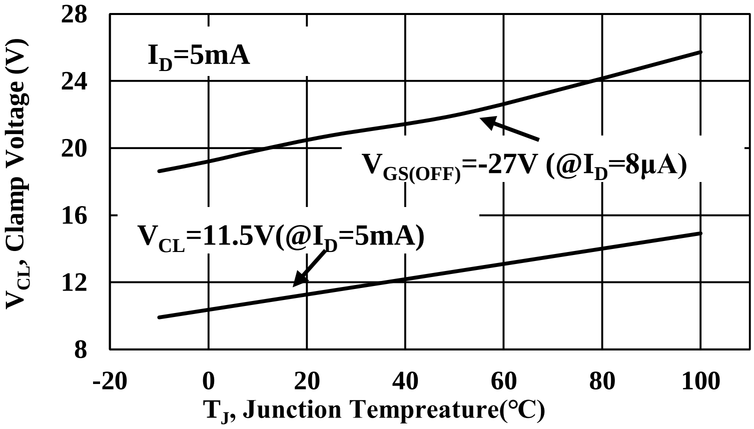
8μA≤$I_D$≤5mA, the clamping voltage: 11.5V≤$V_{CL}$≤27V. Figure 7 shows the clamping voltage $V_{CL}$ lower limit of 11.5V and the threshold voltage $V_{GS(OFF)}$ upper limit of $V_{GS(OFF)}$ =-27V, and the clamping working voltage distribution when the working current does not exceed 5mA.

**Figure 7. Clamp Voltage vs. Drain Current**




The clamping voltage will also change with the temperature. When the working temperature increases, the clamping voltage will increase; when the working temperature decreases, the clamping voltage will also decrease.

**Figure 8. Clamp Voltage vs. Junction Temperature**

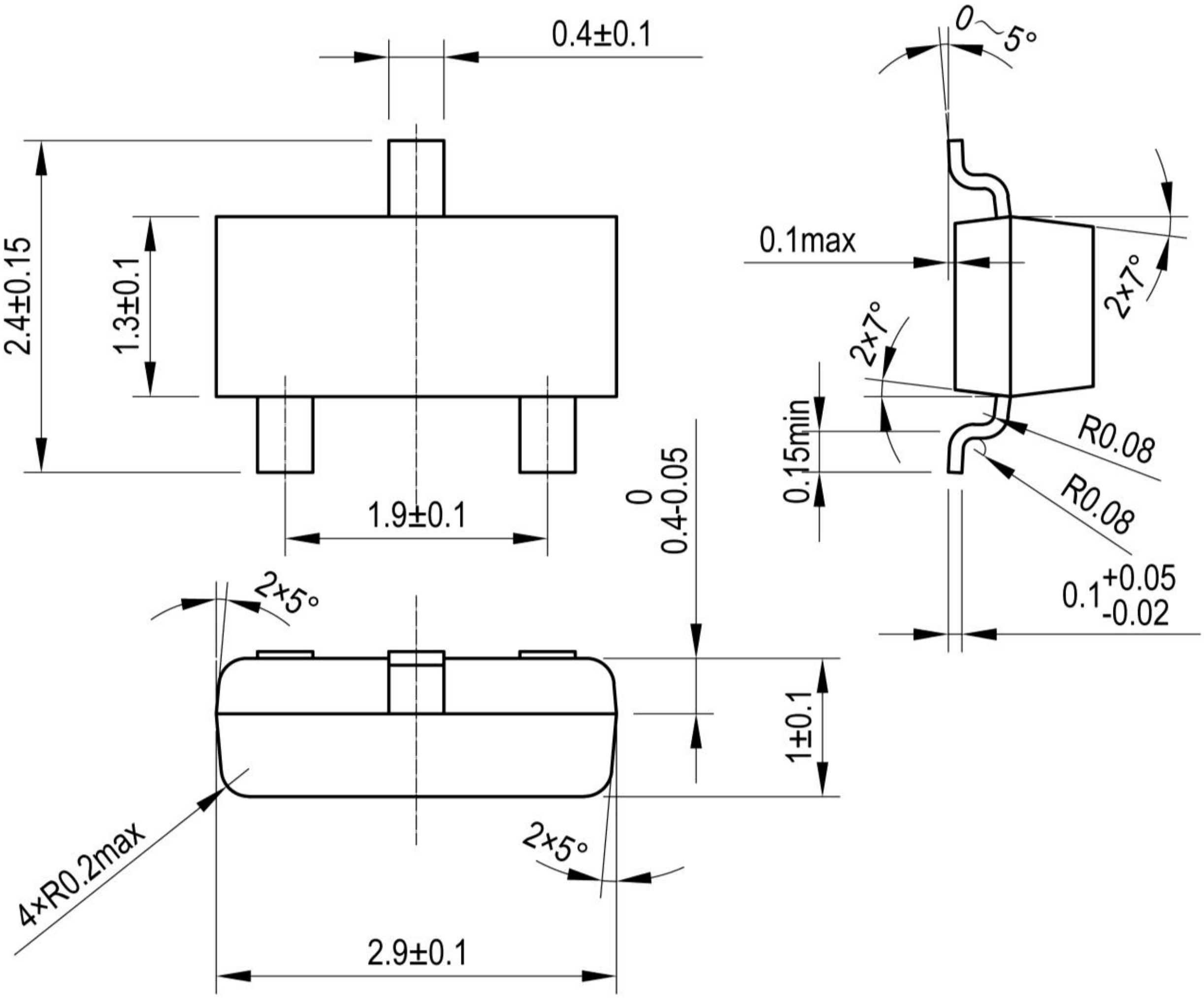



As shown in Figure 8, in the practical application of DMZ1015E/DMX1015E, with the increase of device temperature, its output voltage will also increase, and the drain-source voltage will decrease, so that the device's power consumption will also decrease. In this way, the temperature of DMZ1015E/DMX1015E will decrease. This negative feedback mechanism enables DMZ1015E/ DMX1015E to reach a stable thermal equilibrium state.

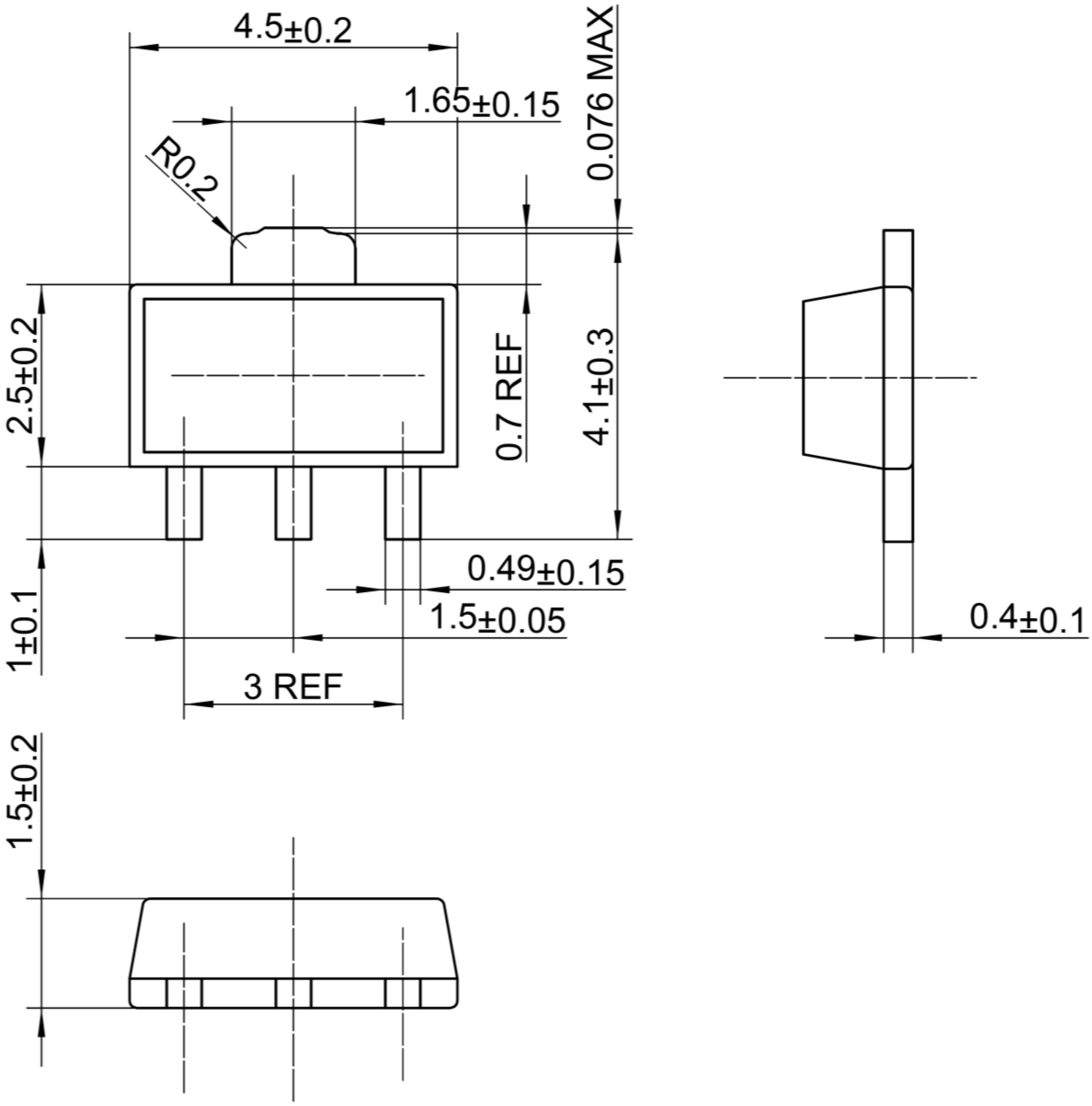
Ultra-high threshold voltage depletion mode MOSFET and its application were first proposed by ARK Microelectronics Co., LTD. Design engineers can determine the applicable range of DMZ1015E/DMX1015E according to the product specifications of DMZ1015E/DMX1015E and this application note.

## Package Dimensions

SOT-23



# SOT-89


4.5±0.2
1.65±0.15
0.076 MAX
R0.2
2.5±0.2
0.7 REF
4.1±0.3
0.49±0.15
1.5±0.05
1±0.1
3 REF
0.4±0.1
1.5±0.2

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