

Ultrahigh Threshold Voltage Depletion-Mode Power MOSFET

General Features

- ESD Improved Capability
- Depletion Mode (Normally On)
- Proprietary Advanced Planar Technology
- Proprietary Advanced Ultrahigh V_{th} 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 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 _{θJA}	Thermal Resistance, Junction-to-Ambient	250	125	K/W

Electrical Characteristics

OFF Characteristics

 $T_A = 25^\circ\text{C}$ unless otherwise specified

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

ON Characteristics

 $T_A = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Conditions
I_{DSS}	Saturated Drain-to-Source Current	100	--	--	mA	$V_{GS} = 0\text{V}, V_{DS} = 25\text{V}$
$R_{DS(ON)}$	Static Drain-to-Source On-Resistance	--	--	10	Ω	$V_{GS} = 0\text{V}, I_D = 100\text{mA}^{[4]}$
$V_{GS(OFF)}$	Gate-to-Source Cut-off Voltage	--	--	-27	V	$V_{DS} = 9\text{V}, I_D = 8\mu\text{A}$
V_{CL}	Source-to-Gate Clamp Voltage	11.5	--	--	V	$V_{DS} = 9\text{V}, I_D = 5\text{mA}$

Source-Drain Diode Characteristics

 $T_A = 25^\circ\text{C}$ unless otherwise specified

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

NOTE:

[1] $T_J = +25^\circ\text{C}$ to $+150^\circ\text{C}$

[2] Repetitive rating, pulse width limited by maximum junction temperature.

[3] The test is based on JEDEC EIA/JESD22-A114 (HBM).

[4] Pulse width $\leq 380\mu\text{s}$; duty cycle $\leq 2\%$.

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:

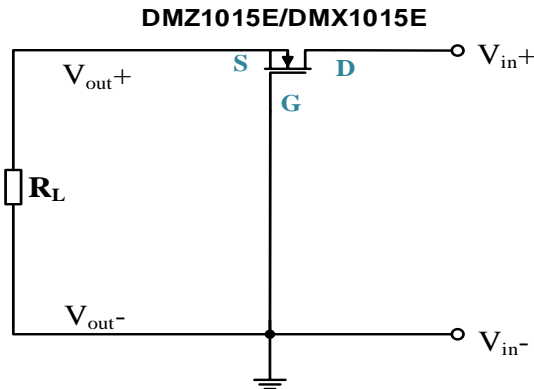
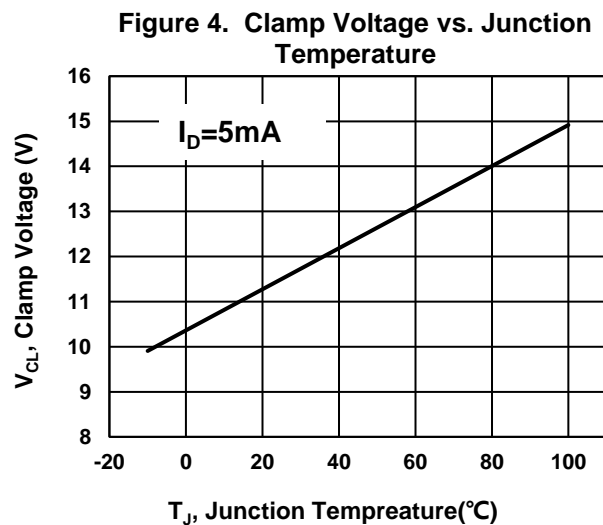
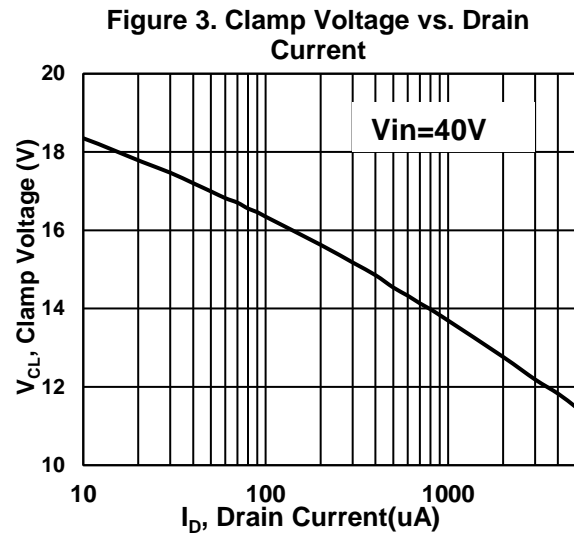
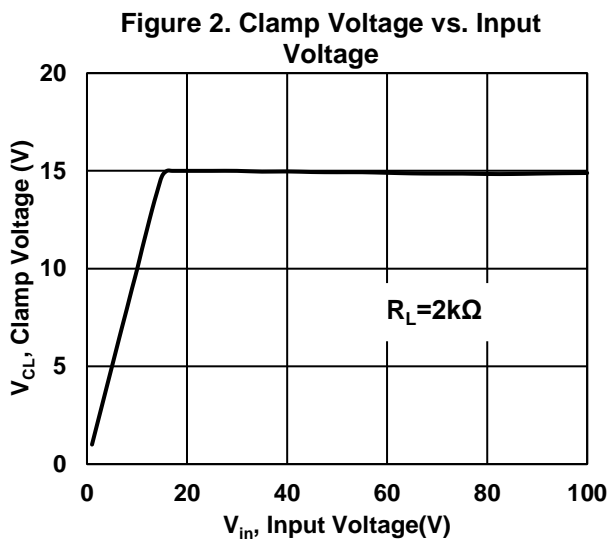


Figure1. Drain Current I_D is decided by Load Resistance



Typical Application

In the QC2.0/3.0 and Type-C/PD charger circuits, using DMZ1015E/DMX1015E as a high voltage linear regulators 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.

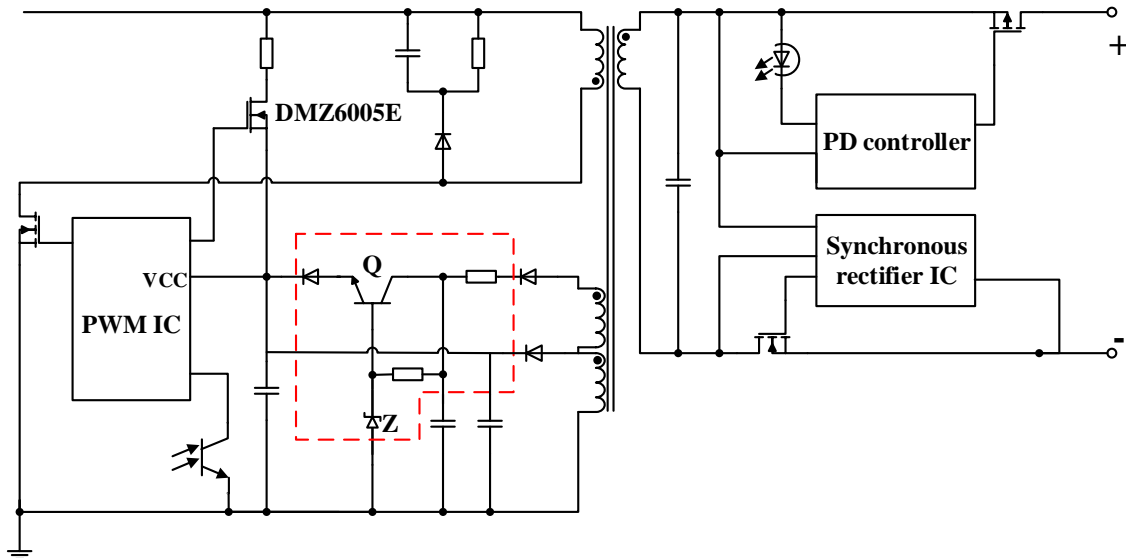


Figure 5. Normal Circuit with Transistor and Diode

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

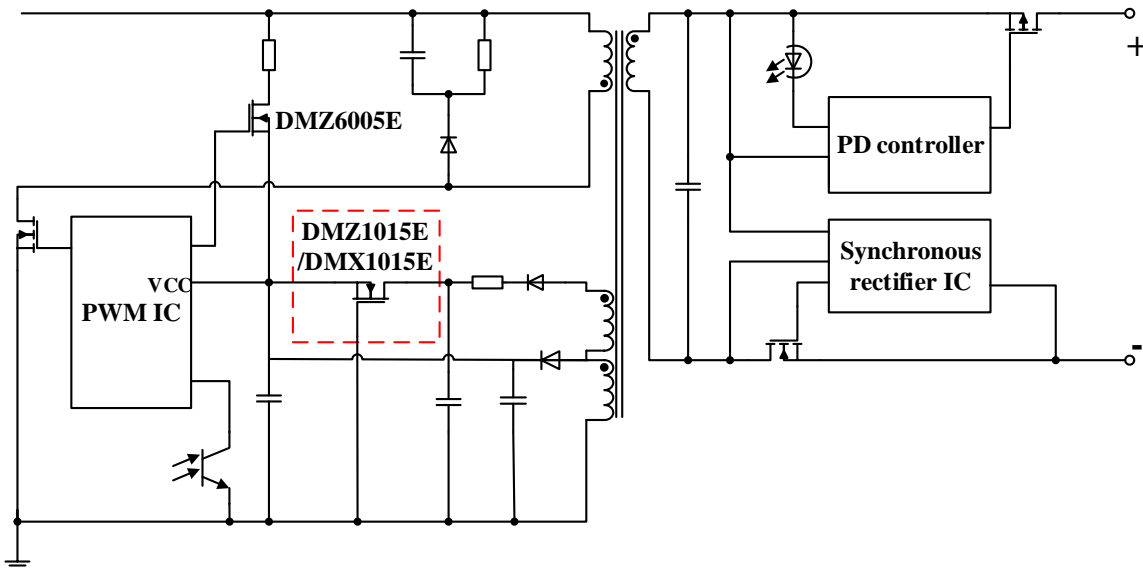
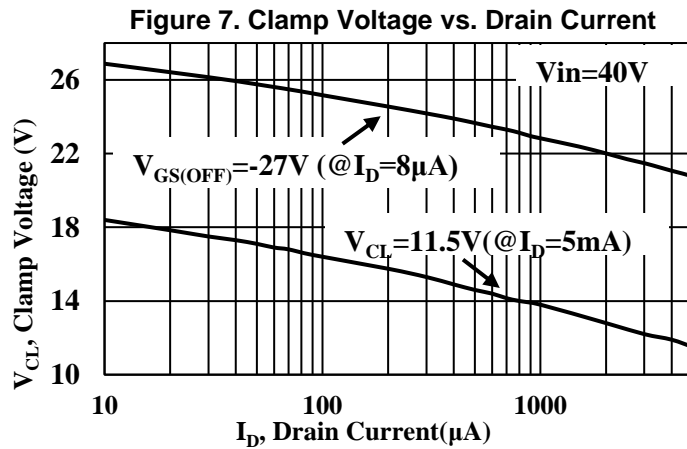


Figure 6. Circuit with DMZ1015E/DMX1015E

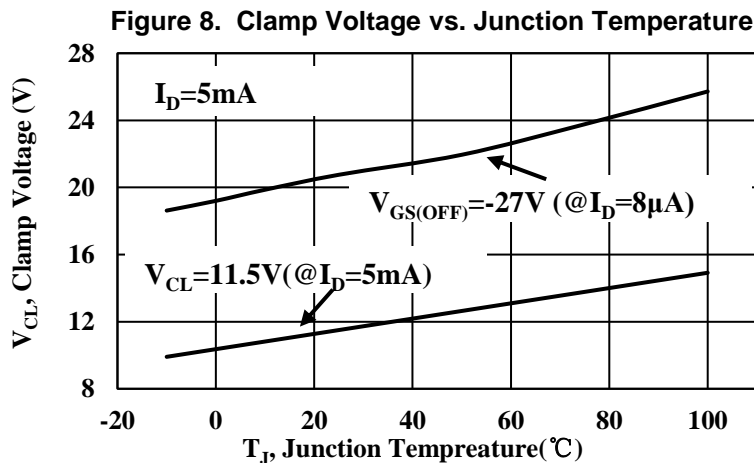
At room temperature and under 2~4mA working current (most IC's working current), the output voltage of DMZ1015E/DMX1015E is between 12~22V.

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 $I_D = 8\mu A$), 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

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

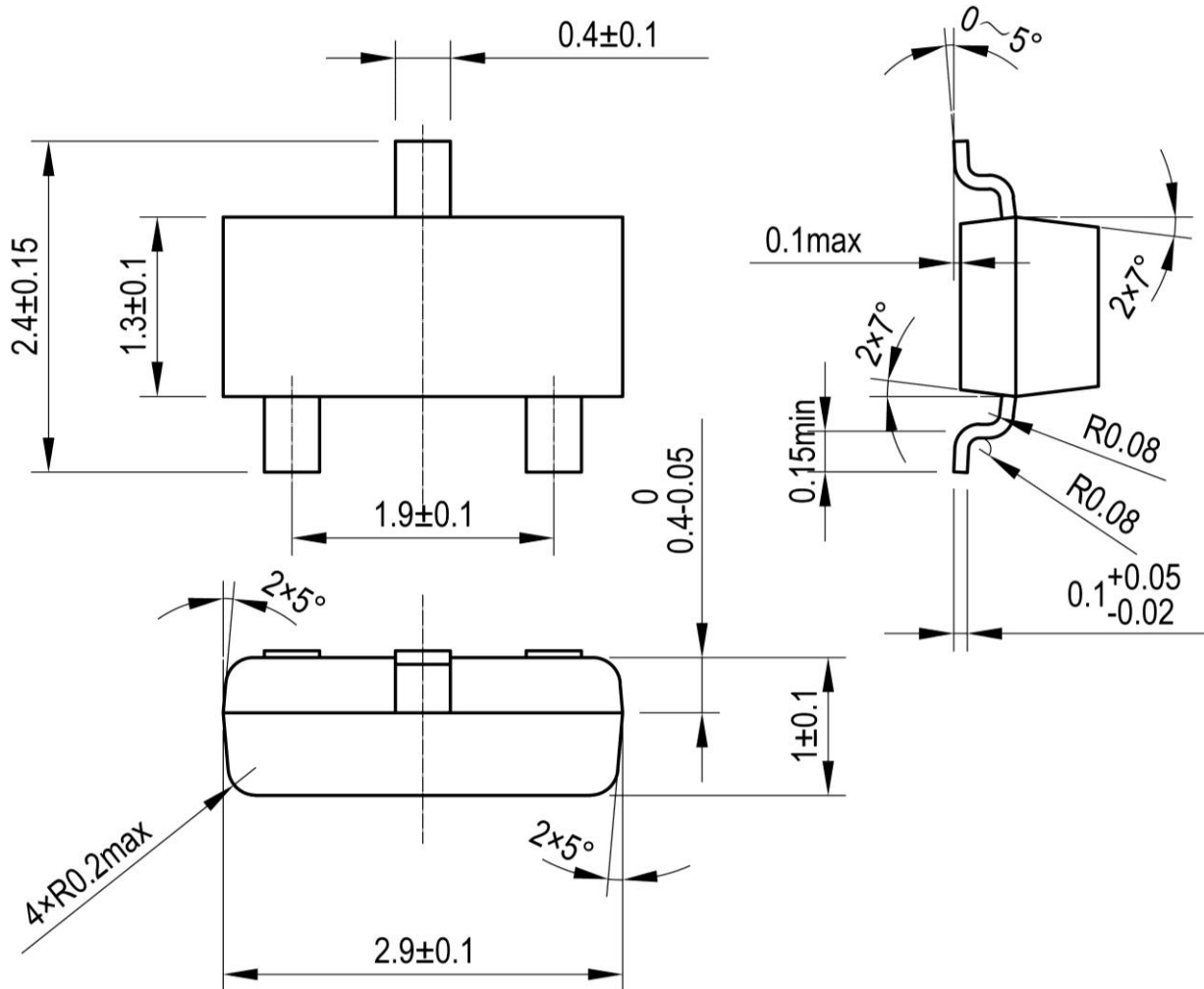


The clamping voltage will also change with the temperature. When the working temperature increases, the clamping voltage will increase; when the working temperature decreases, the clamping voltage will also decrease.

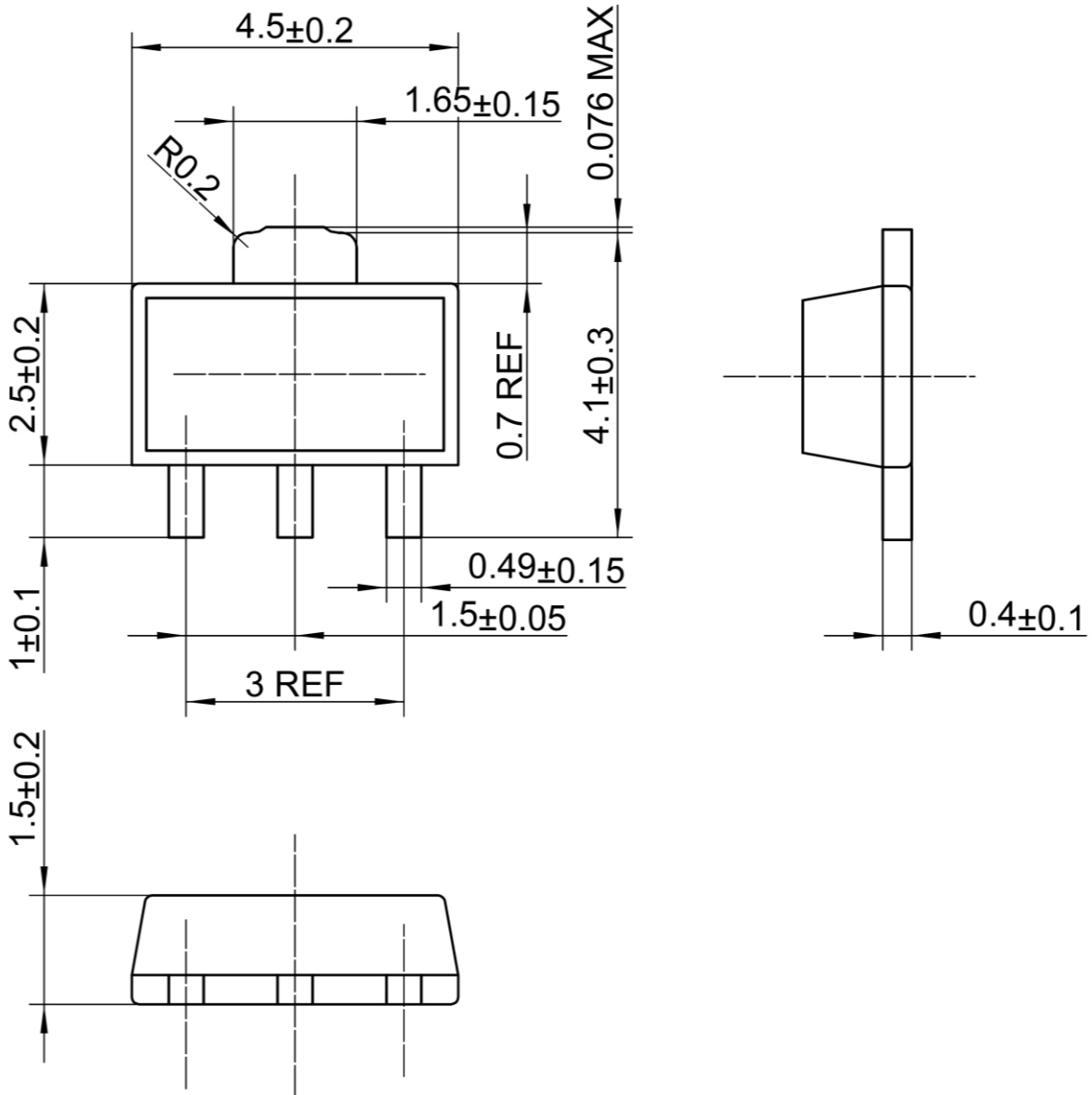


As shown in Figure 8, in the practical application of DMZ1015E/DMX1015E, with the increase of device temperature, its output voltage will also increase, and the drain-source voltage will decrease, so that the device's power consumption will also decrease. In this way, the temperature of DMZ1015E/DMX1015E 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





Published by

ARK Microelectronics Co., Ltd.

ADD: D26,UESTC National Science Park No. 1 Shuangxing Avenue, Chengdu, Sichuan.

All Rights Reserved.

Disclaimers

ARK Microelectronics Co., Ltd. reserves the right to make change without notice in order to improve reliability, function or design and to discontinue any product or service without notice. Customers should obtain the latest relevant information before orders and should verify that such information is current and complete. All products are sold subject to ARK Microelectronics Co., Ltd's terms and conditions supplied at the time of order acknowledgement.

ARK Microelectronics Co., Ltd. warrants performance of its hardware products to the specifications at the time of sale, Testing, reliability and quality control are used to the extent ARK Microelectronics Co., Ltd deems necessary to support this warrantee. Except where agreed upon by contractual agreement, testing of all parameters of each product is not necessary performed.

ARK Microelectronics Co., Ltd. does not assume any liability arising from the use of any product or circuit designs described herein. Customers are responsible for their products and applications using ARK Microelectronics Co., Ltd's components. To minimize risk, customers must provide adequate design and operating safeguards.

ARK Microelectronics Co., Ltd. does not warrant or convey any license either expressed or implied under its patent rights, nor the rights of others. Reproduction of information in ARK Microelectronics Co., Ltd's data sheets or data books is permissible only if reproduction is without modification or alteration. Reproduction of this information with any alteration is an unfair and deceptive business practice. ARK Microelectronics Co., Ltd is not responsible or liable for such altered documentation.

Resale of ARK Microelectronics Co., Ltd's products with statements different from or beyond the parameters stated by ARK Microelectronics Co., Ltd. for the product or service voids all express or implied warranties for the associated ARK Microelectronics Co., Ltd's product or service and is unfair and deceptive business practice. ARK Microelectronics Co., Ltd is not responsible or liable for any such statements.

Life Support Policy:

ARK Microelectronics Co., Ltd's products are not authorized for use as critical components in life devices or systems without the expressed written approval of ARK Microelectronics Co., Ltd.

As used herein:

1. Life support devices or systems are devices or systems which:
 - a. are intended for surgical implant into the human body,
 - b. support or sustain life,
 - c. whose failure to perform when properly used in accordance with instructions for used provided in the labeling, can be reasonably expected to result in significant injury to the user.
 2. A critical component is any component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.
-