WILLAS

RoHS COMPLIANT

**2N7002KLT1**

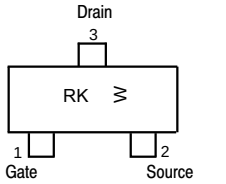
## 380mA N-Channel Small Signal MOSFET - 60V

### PRIMARY CHARACTERISTICS

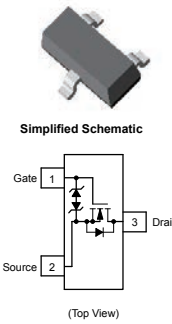
| $V_{(BR)DSS}$ | $R_{DS(on)}$ MAX | $I_D$ MAX (Note 1) |
|---|---|---|
| 60 V | 2.3 Ω @ 10 V | 380 mA |
| | 2.7 Ω @ 5.0 V | |

### SOT-23 PACKAGE

**MARKING DIAGRAM & PIN ASSIGNMENT**




RK = Device Code
W = Month Code




### FEATURES

- ESD Protected
- Low $R_{DS(on)}$
- Surface Mount Package
- This is a Pbī Free Device
- We declare that the material of product are Halogen Free and compliance with RoHS requirements.

### APPLICATIONS

- Low Side Load Switch
- Level Shift Circuits
- DCī DC Converter
- Portable Applications i.e. DSC, PDA,Cell Phone,etc.

### MAXIMUM RATINGS ($T_J$ = 25°C unless otherwise stated)

| Rating | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain−to−Source Voltage | | $V_{DSS}$ | 60 | V |
| Gate−to−Source Voltage | | $V_{GS}$ | ±20 | V |
| Drain Current (Note 1) Steady State | $T_A$ = 25°C | $I_D$ | 320 | mA |
| | $T_A$ = 85°C | | 230 | |
| t < 5 s | $T_A$ = 25°C | | 380 | |
| | $T_A$ = 85°C | | 270 | |
| Power Dissipation (Note 1) Steady State | | $P_D$ | 300 | mW |
| t < 5 s | | | 420 | |
| Pulsed Drain Current ($t_p$ = 10 μs) | | $I_{DM}$ | 1. 5 | A |
| Operating Junction and Storage Temperature Range | | $T_J$, $T_{STG}$ | −55 to +150 | °C |
| Source Current (Body Diode) | | $I_S$ | 300 | mA |
| Lead Temperature for Soldering Purposes (1/8″ from case for 10 s) | | $T_L$ | 260 | °C |
| Gate−Source ESD Rating (HBM, Method 3015) | | ESD | 2000 | V |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Junction−to−Ambient − Steady State (Note 1) | $R_{\theta JA}$ | 417 | °C/W |
| Junction−to−Ambient − t ≤ 5 s (Note 1) | $R_{\theta JA}$ | 300 | |

1. Surface−mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces)

## ELECTRICAL CHARACTERISTICS ($T_J$ = 25°C unless otherwise specified)

| Parameter | Symbol | Test Condition | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain–to–Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$ = 0 V, $I_D$ = 250 μA | | 60 | | | V |
| Drain–to–Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ | | | | 71 | | mV/°C |
| Zero Gate Voltage Drain Current | $I_{DSS}$ | $V_{GS}$ = 0 V, $V_{DS}$ = 60 V | $T_J$ = 25°C | | | 1 | μA |
| | | | $T_J$ = 125°C | | | 500 | |
| | | $V_{GS}$ = 0 V, $V_{DS}$ = 50 V | $T_J$ = 25°C | | | 100 | nA |
| Gate–to–Source Leakage Current | $I_{GSS}$ | $V_{DS}$ = 0 V, $V_{GS}$ = ±20 V | | | | ±10 | μA |
| **ON CHARACTERISTICS** (Note 2) | | | | | | | |
| Gate Threshold Voltage | $V_{GS(TH)}$ | $V_{GS}$ = $V_{DS}$, $I_D$ = 250 μA | | 1.0 | | 2.5 | V |
| Negative Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ | | | | 4.0 | | mV/°C |
| Drain–to–Source On Resistance | $R_{DS(on)}$ | $V_{GS}$ = 10 V, $I_D$ = 500 mA | | | | 2.3 | Ω |
| | | $V_{GS}$ = 5.0 V, $I_D$ = 50 mA | | | | 2.7 | |
| Forward Transconductance | $g_{FS}$ | $V_{DS}$ = 5 V, $I_D$ = 200 mA | | 80 | | | mS |
| **CHARGES AND CAPACITANCES** | | | | | | | |
| Input Capacitance | $C_{ISS}$ | $V_{GS}$ = 0 V, f = 1 MHz, $V_{DS}$ = 25 V | | | 34 | | pF |
| Output Capacitance | $C_{OSS}$ | | | | 3 | | |
| Reverse Transfer Capacitance | $C_{RSS}$ | | | | 2.2 | | |
| Total Gate Charge | $Q_{G(TOT)}$ | $V_{GS}$ = 4.5 V, $V_{DS}$ = 10 V; $I_D$ = 500 mA | | | 0.71 | | nC |
| Threshold Gate Charge | $Q_{G(TH)}$ | | | | 0.1 | | |
| Gate–to–Source Charge | $Q_{GS}$ | | | | 0.32 | | |
| Gate–to–Drain Charge | $Q_{GD}$ | | | | 0.16 | | |
| **SWITCHING CHARACTERISTICS, $V_{GS}$ = V** (Note 3) | | | | | | | |
| Turn–On Delay Time | $t_{d(ON)}$ | $V_{DS}$ = 10 V, $V_{GEN}$ = 10 V, $I_D$ = 500 mA | | | 3.8 | | ns |
| Rise Time | $t_r$ | | | | 3.4 | | |
| Turn–Off Delay Time | $t_{d(OFF)}$ | | | | 19 | | |
| Fall Time | $t_f$ | | | | 12 | | |
| **DRAIN–SOURCE DIODE CHARACTERISTICS** | | | | | | | |
| Forward Diode Voltage | $V_{SD}$ | $V_{GS}$ = 0 V, $I_S$ = 115 mA | $T_J$ = 25°C | | | 1.4 | V |
| | | | $T_J$ = 85°C | | 0.7 | | |

2. Pulse Test: pulse width ≤ 300 μs, duty cycle ≤ 2%
3. Switching characteristics are independent of operating junction temperatures

## TYPICAL ELECTRICAL CHARACTERISTICS

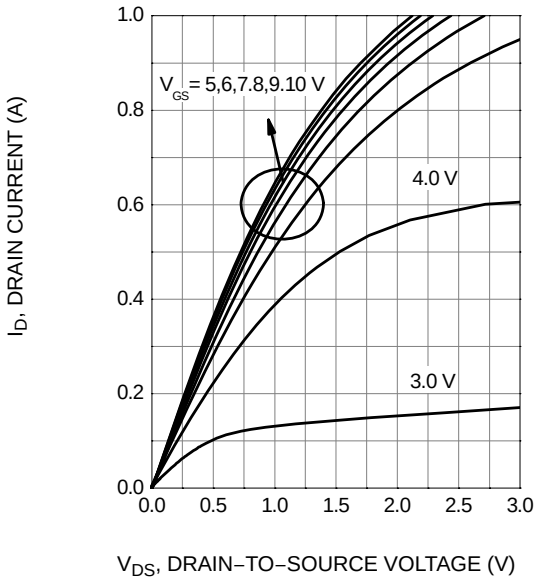



**Figure 1. On−Region Characteristics**

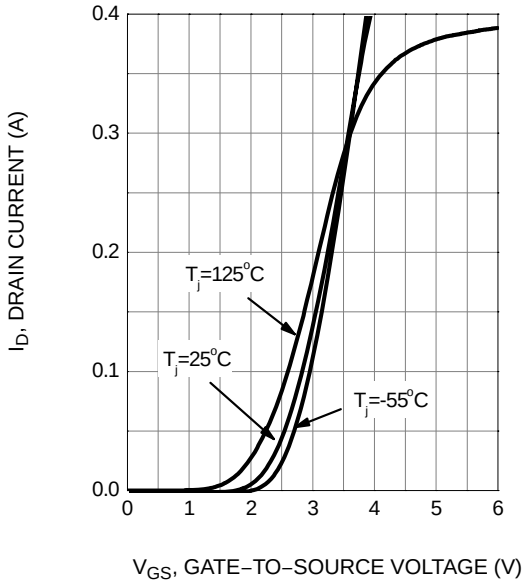



**Figure 2. Transfer Characteristics**

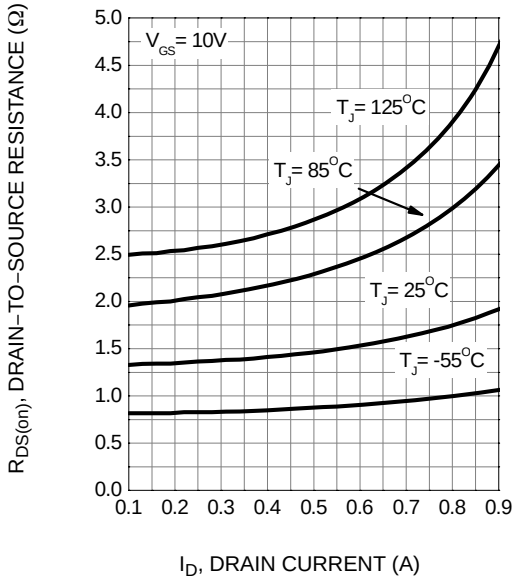



**Figure 3. On−Resistance vs. Drain Current and Temperature**

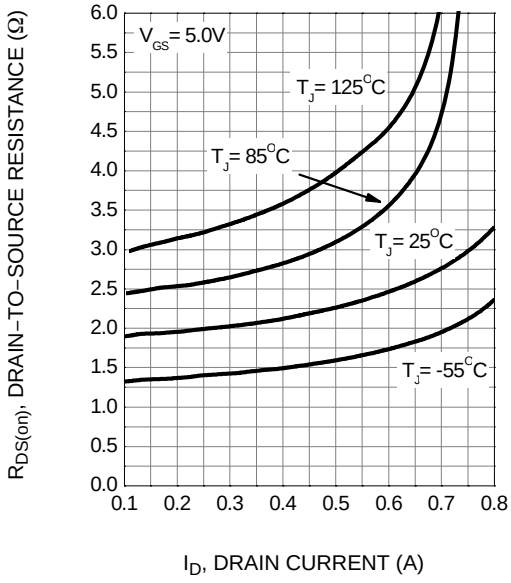



**Figure 4. On−Resistance vs. Drain Current and Temperature**

## TYPICAL ELECTRICAL CHARACTERISTICS

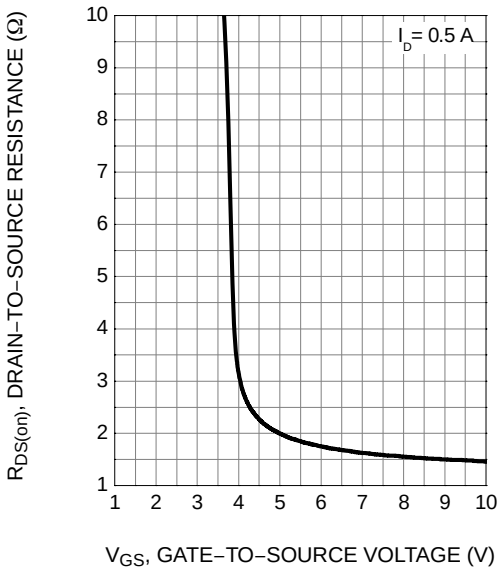



**Figure 5. On–Resistance vs. Gate–to–Source Voltage**

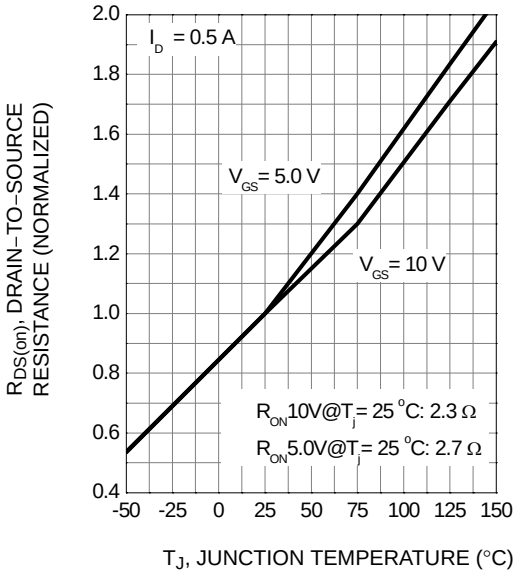



**Figure 6. On–Resistance Variation with Temperature**

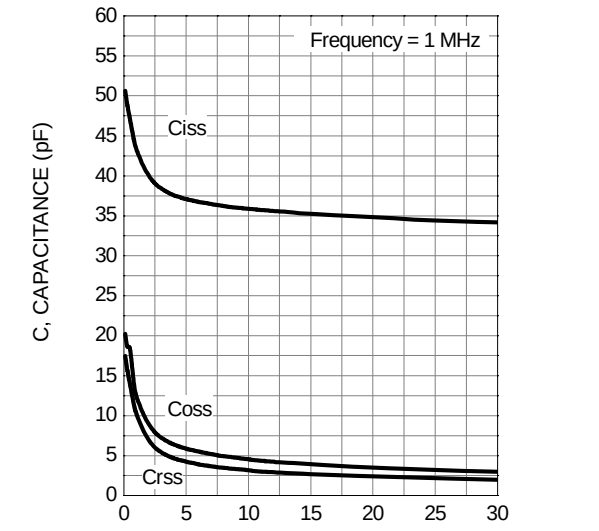



**Figure 7. Capacitance Variation**

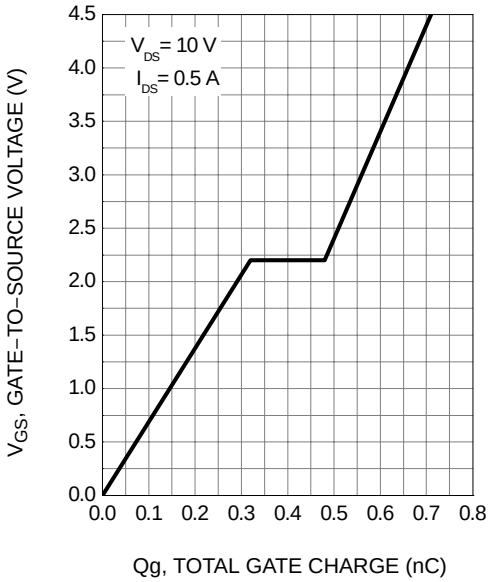



**Figure 8. Gate–to–Source and Drain–to–Source Voltage vs. Total Charge**

## TYPICAL ELECTRICAL CHARACTERISTICS

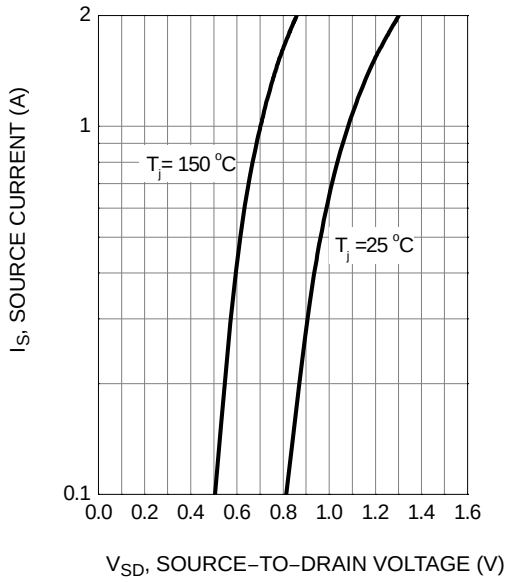
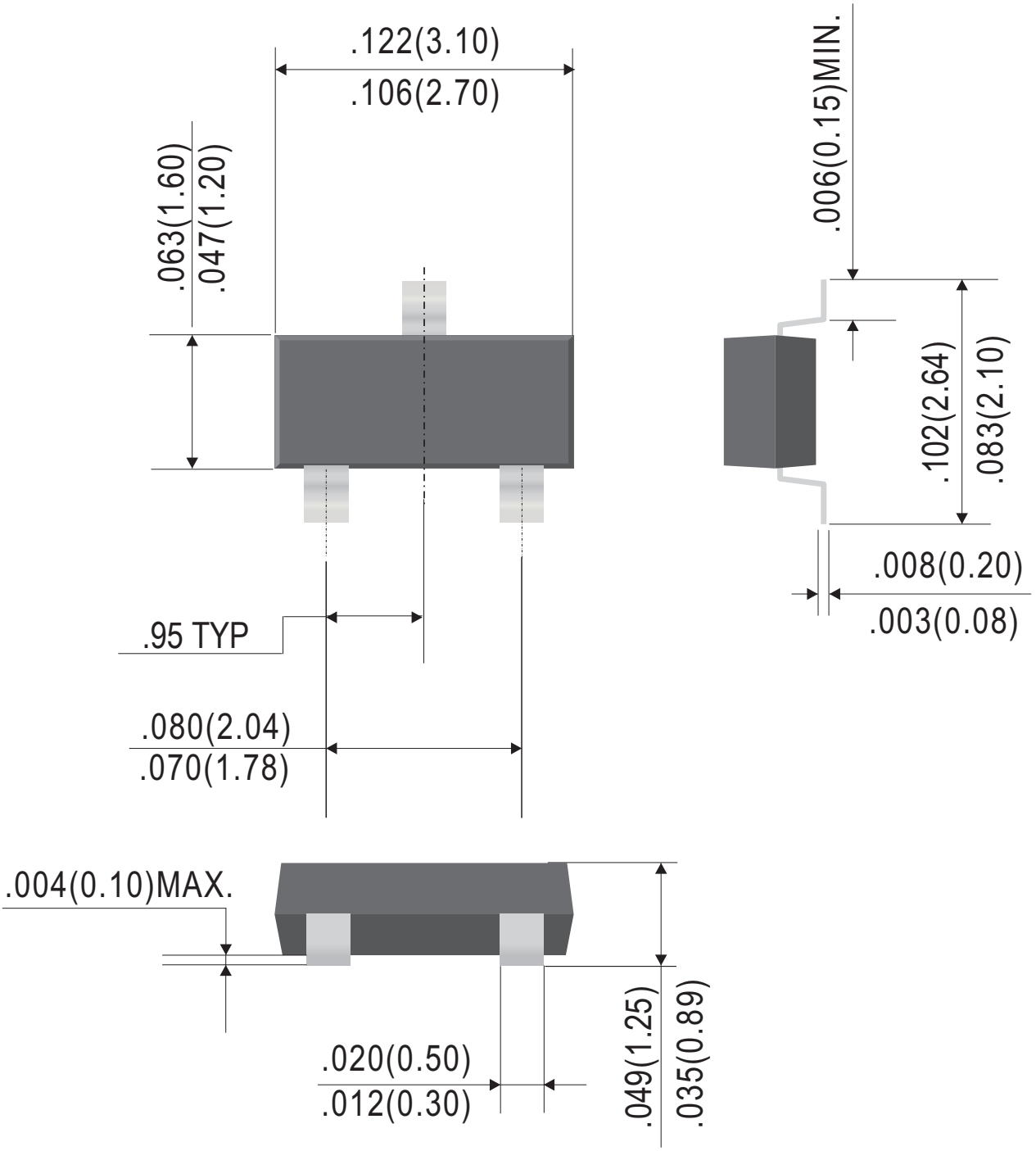



**Figure 9. Diode Forward Voltage vs. Current**

# Outline Drawing

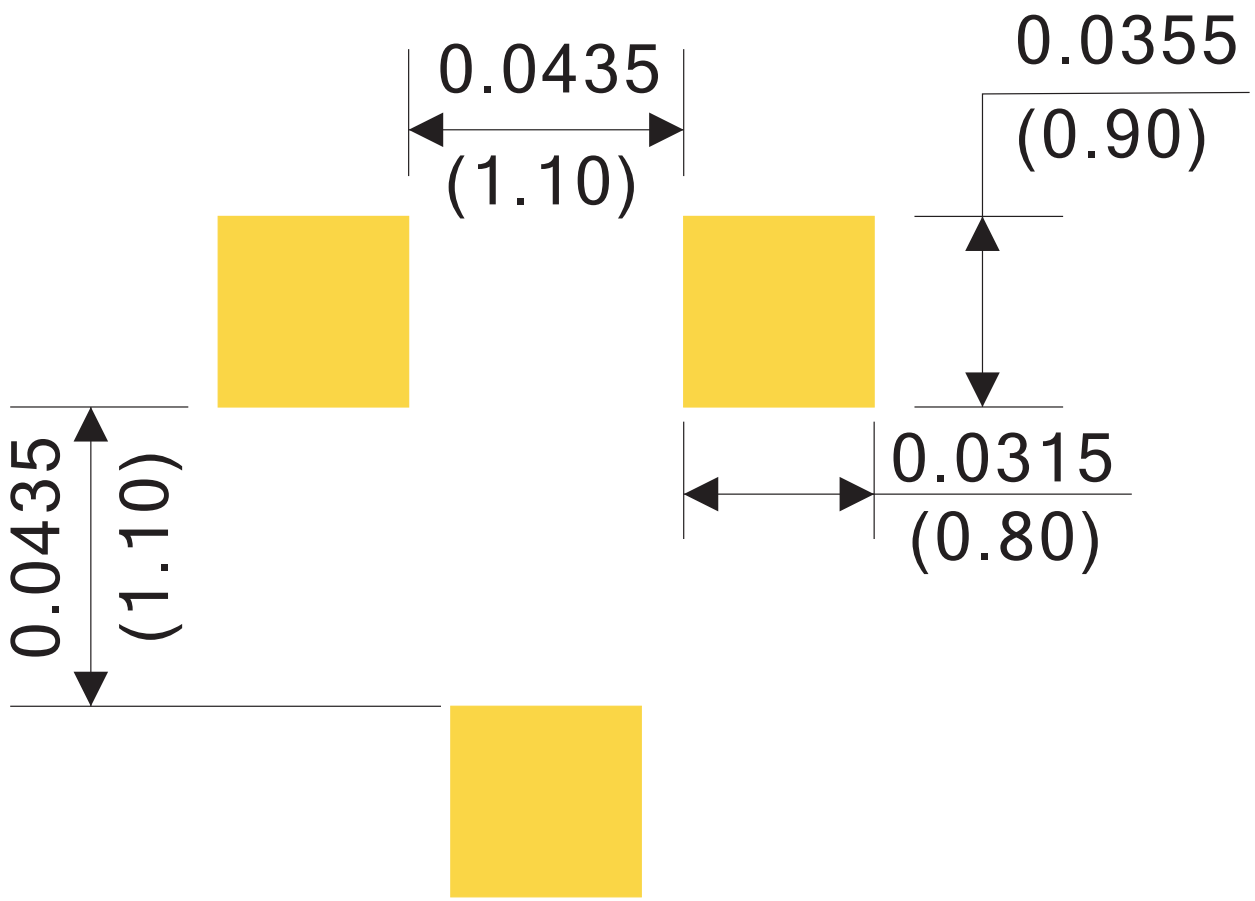
# SOT-23




Dimensions in inches and (millimeters)

Rev.E

| Suggested Soldering Pad Layout | SOT-23 |
|---|---|




Dimensions in inches and (millimeters)

RevA

## Ordering Information:

| Device PN | Packing |
|---|---|
| 2N7002KLT1 -T(1) H(2)-WS | Tape&Reel: 3 Kpcs/Reel |

Note: (1) Packing code, Tape & Reel Packing

(2) Halogen free product for packing code suffix "H"