

## Description

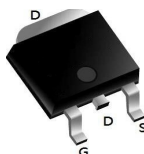
The 20N03 is the high cell density trench N-ch MOSFETs, which provide excellent RDSON and gate charge for most of the synchronous buck converter applications.

The 20N03 meet the RoHS and Green Product requirement, 100% EAS guaranteed with full function reliability approved

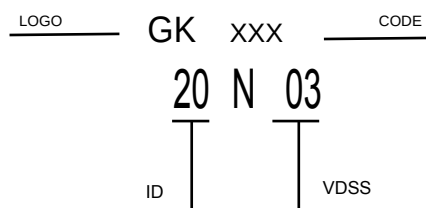
## Features

Super Low Gate Charge  
100% EAS Guaranteed  
Green Device Available  
Excellent CdV/dt effect decline  
Advanced high cell density Trench technology

TO-252



$V_{DS}$  30 V  
 $I_D$  20 A  
 $R_{DS(ON)}$  15mΩ



## MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

| Symbol                 | Parameter                                             | Rating     |              | Units |
|------------------------|-------------------------------------------------------|------------|--------------|-------|
|                        |                                                       | 10s        | Steady State |       |
| $V_{DS}$               | Drain-Source Voltage                                  | 30         |              | V     |
| $V_{GS}$               | Gate-Source Voltage                                   | ±20        |              | V     |
| $I_D@T_C=25^{\circ}C$  | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup> | 20         |              | A     |
| $I_D@T_C=100^{\circ}C$ | Continuous Drain Current, $V_{GS}$ @ 10V <sup>1</sup> | 8          |              | A     |
| $I_{DM}$               | Pulsed Drain Current <sup>2</sup>                     | 38         |              | A     |
| EAS                    | Single Pulse Avalanche Energy <sup>3</sup>            | 28         |              | mJ    |
| $I_{AS}$               | Avalanche Current                                     | 13.8       |              | A     |
| $P_D@T_C=25^{\circ}C$  | Total Power Dissipation <sup>4</sup>                  | 5.5        |              | W     |
| $T_{STG}$              | Storage Temperature Range                             | -55 to 175 |              | °C    |
| $T_J$                  | Operating Junction Temperature Range                  | -55 to 175 |              | °C    |

### Thermal Data

| Symbol          | Parameter                                     | Typ. | Max. | Unit |
|-----------------|-----------------------------------------------|------|------|------|
| $R_{\theta JC}$ | Thermal Resistance Junction-Case <sup>1</sup> | ---  | 36   | °C/W |

## Electrical Characteristics ( $T_J=25^{\circ}\text{C}$ unless otherwise noted)

| Symbol                                                 | Parameter                                                 | Test Condition                                                                          | Min. | Typ. | Max. | Units |
|--------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------------------|------|------|------|-------|
| Off Characteristic                                     |                                                           |                                                                                         |      |      |      |       |
| V <sub>(BR)DSS</sub>                                   | Drain-Source Breakdown Voltage                            | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                              | 30   | -    | -    | V     |
| I <sub>DSS</sub>                                       | Zero Gate Voltage Drain Current                           | V <sub>DS</sub> =30V, V <sub>GS</sub> = 0V,                                             | -    | -    | 1.0  | μA    |
| I <sub>GSS</sub>                                       | Gate to Body Leakage Current                              | V <sub>DS</sub> =0V, V <sub>GS</sub> = ±20V                                             | -    | -    | ±100 | nA    |
| On Characteristics                                     |                                                           |                                                                                         |      |      |      |       |
| V <sub>GS(th)</sub>                                    | Gate Threshold Voltage                                    | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                | 1.0  | 1.5  | 2.5  | V     |
| R <sub>DS(on)</sub>                                    | Static Drain-Source on-Resistance<br><small>note3</small> | V <sub>GS</sub> =10V, I <sub>D</sub> =5A                                                | -    | 15   | 20   | mΩ    |
|                                                        |                                                           | V <sub>GS</sub> =4.5V, I <sub>D</sub> =3A                                               | -    | 21   | 29   |       |
| Dynamic Characteristics                                |                                                           |                                                                                         |      |      |      |       |
| C <sub>iss</sub>                                       | Input Capacitance                                         | V <sub>DS</sub> =15V, V <sub>GS</sub> =0V,<br>f=1.0MHz                                  | -    | 490  | -    | pF    |
| C <sub>oss</sub>                                       | Output Capacitance                                        |                                                                                         | -    | 79   | -    | pF    |
| C <sub>rss</sub>                                       | Reverse Transfer Capacitance                              |                                                                                         | -    | 61   | -    | pF    |
| Q <sub>g</sub>                                         | Total Gate Charge                                         | V <sub>DS</sub> =15V, I <sub>D</sub> =5.8A,<br>V <sub>GS</sub> =10V                     | -    | 10   | -    | nC    |
| Q <sub>gs</sub>                                        | Gate-Source Charge                                        |                                                                                         | -    | 1.7  | -    | nC    |
| Q <sub>gd</sub>                                        | Gate-Drain(“Miller”) Charge                               |                                                                                         | -    | 2.5  | -    | nC    |
| Switching Characteristics                              |                                                           |                                                                                         |      |      |      |       |
| t <sub>d(on)</sub>                                     | Turn-on Delay Time                                        | V <sub>DS</sub> =15V, I <sub>D</sub> =3A,<br>V <sub>GS</sub> =10V, R <sub>REN</sub> =3Ω | -    | 6    | -    | ns    |
| t <sub>r</sub>                                         | Turn-on Rise Time                                         |                                                                                         | -    | 15   | -    | ns    |
| t <sub>d(off)</sub>                                    | Turn-off Delay Time                                       |                                                                                         | -    | 17   | -    | ns    |
| t <sub>f</sub>                                         | Turn-off Fall Time                                        |                                                                                         | -    | 17   | -    | ns    |
| Drain-Source Diode Characteristics and Maximum Ratings |                                                           |                                                                                         |      |      |      |       |
| I <sub>S</sub>                                         | Maximum Continuous Drain to Source Diode Forward Current  |                                                                                         | -    | -    | 9    | A     |
| I <sub>SM</sub>                                        | Maximum Pulsed Drain to Source Diode Forward Current      |                                                                                         | -    | -    | 36   | A     |
| V <sub>SD</sub>                                        | Drain to Source Diode Forward Voltage                     | V <sub>GS</sub> =0V, I <sub>S</sub> =9A                                                 | -    | -    | 1.2  | V     |
| trr                                                    | Body Diode Reverse Recovery Time                          | I <sub>F</sub> =5A, dI/dt=100A/μs                                                       | -    | 7    | -    | ns    |
| Qrr                                                    | Body Diode Reverse Recovery Charge                        |                                                                                         | -    | 2    | -    | nC    |

Notes: 1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature

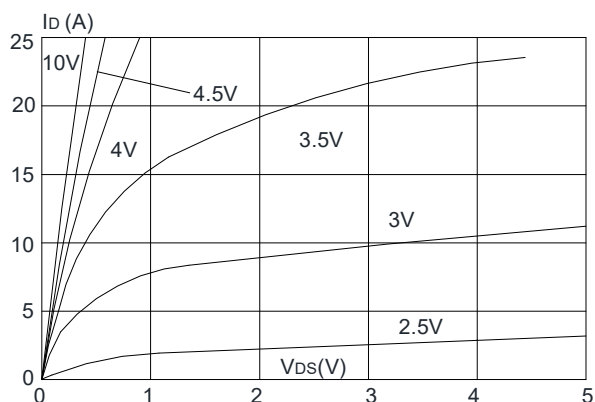
2. EAS condition :  $T_J=25^{\circ}\text{C}, V_{DD}=15V, V_G=10V, L=0.5mH, R_g=25\Omega, I_{AS}=6A$

3. Pulse Test: Pulse Width $\leq 300\mu s$ , Duty Cycle $\leq 0.5\%$

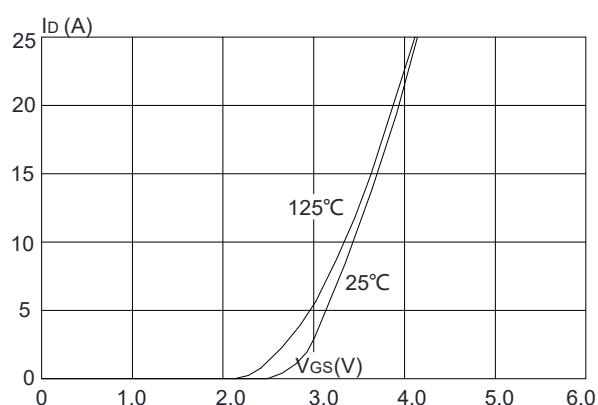


## RATING AND CHARACTERISTIC CURVES

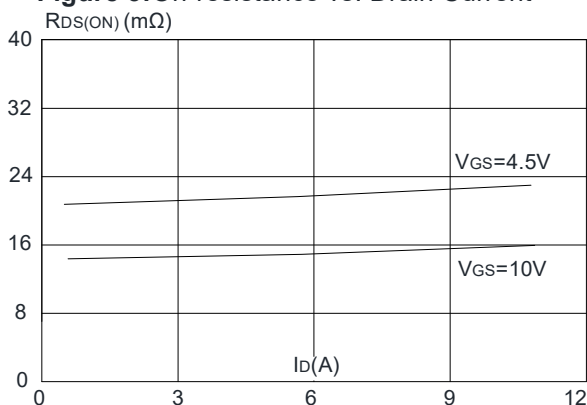
**Figure 1: Output Characteristics**



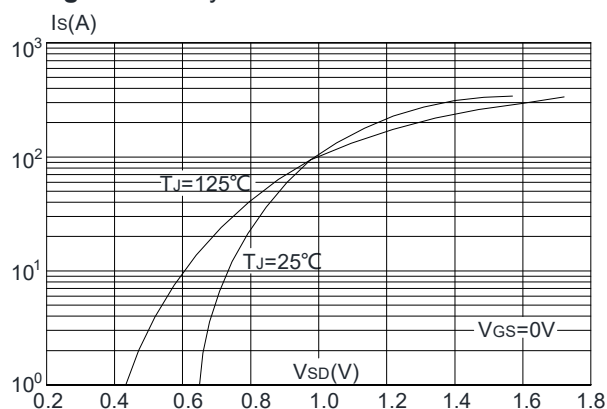
**Figure 2: Typical Transfer Characteristics**



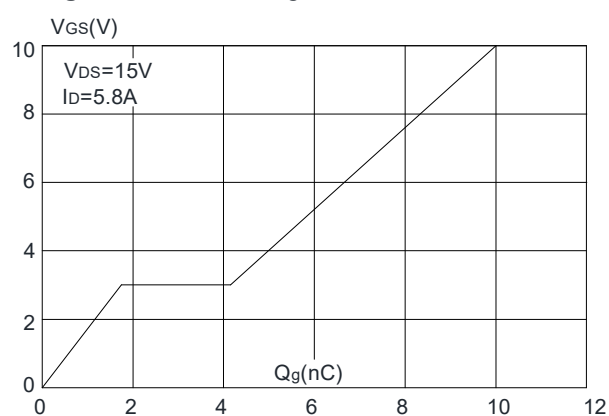
**Figure 3: On-resistance vs. Drain Current**



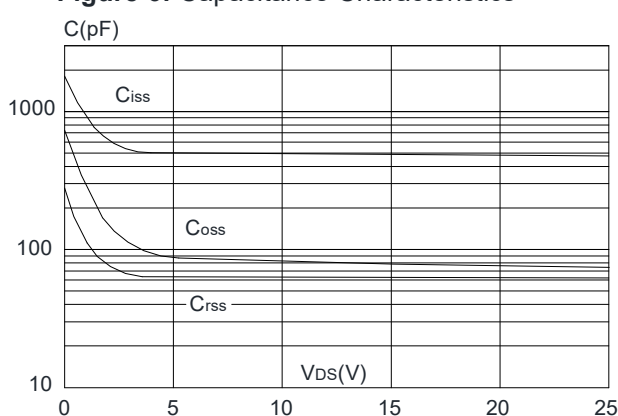
**Figure 4: Body Diode Characteristics**



**Figure 5: Gate Charge Characteristics**

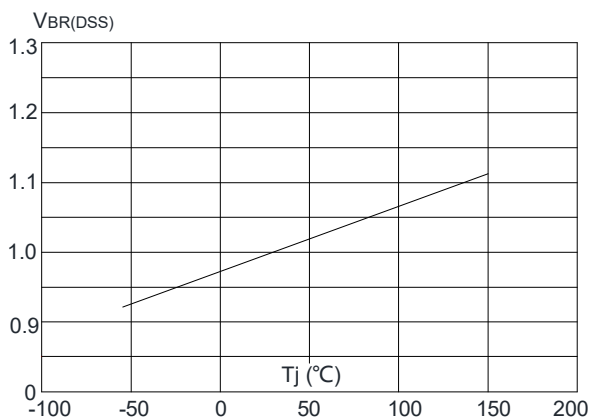


**Figure 6: Capacitance Characteristics**

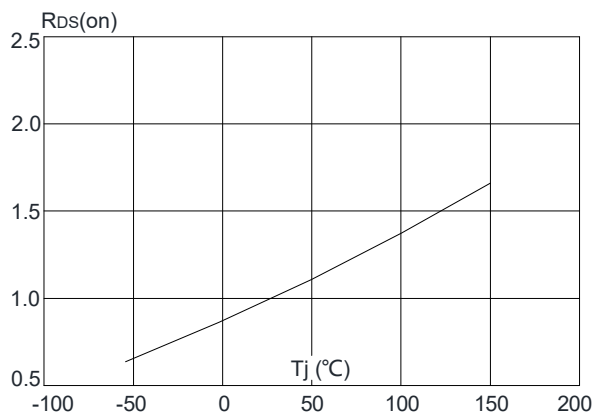


## RATING AND CHARACTERISTIC CURVES

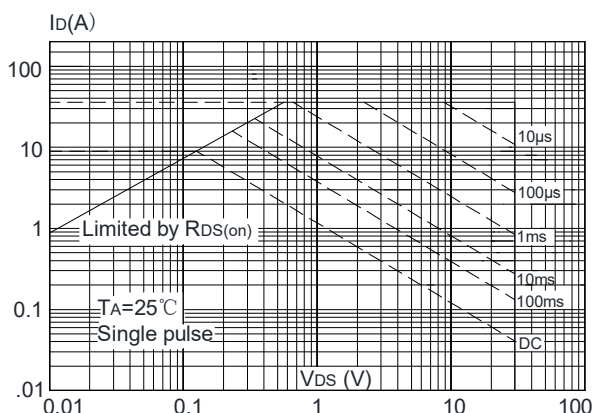
**Figure 7:** Normalized Breakdown Voltage vs. Junction Temperature



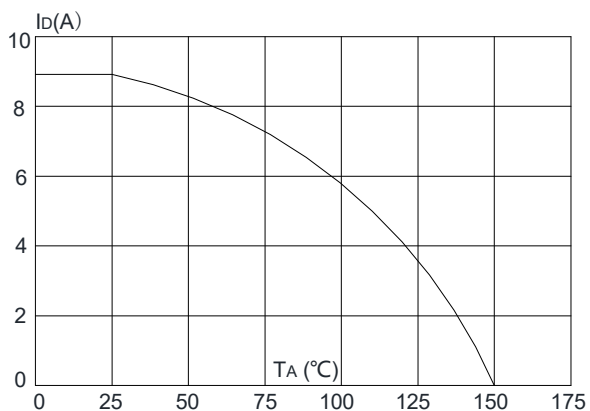
**Figure 8:** Normalized on Resistance vs. Junction Temperature



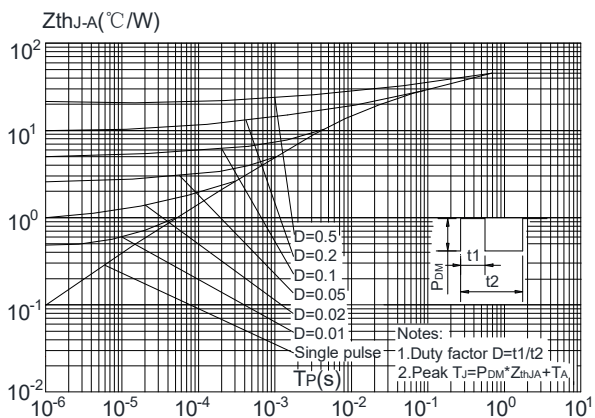
**Figure 9:** Maximum Safe Operating Area



**Figure 10:** Maximum Continuous Drain Current vs. Ambient Temperature



**Figure.11:** Maximum Effective Transient Thermal Impedance, Junction-to-Ambient



## Test Circuit

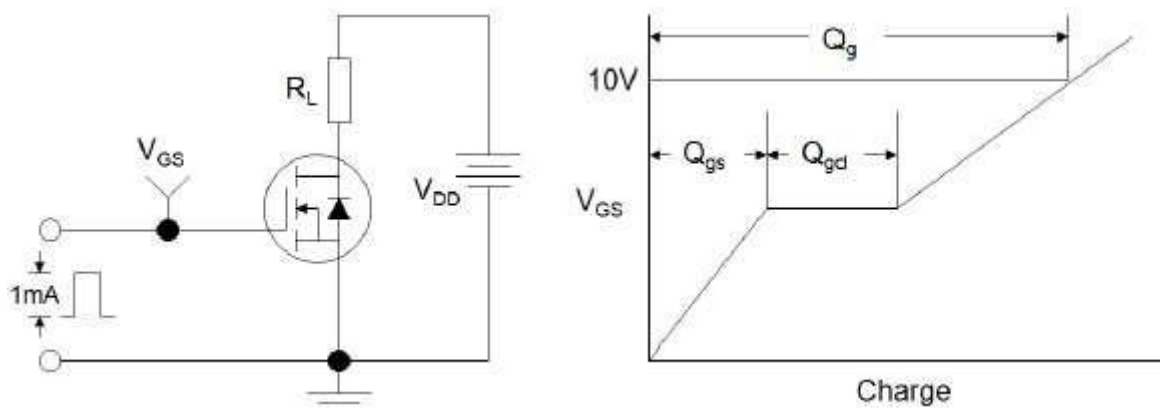


Figure1:Gate Charge Test Circuit & Waveform

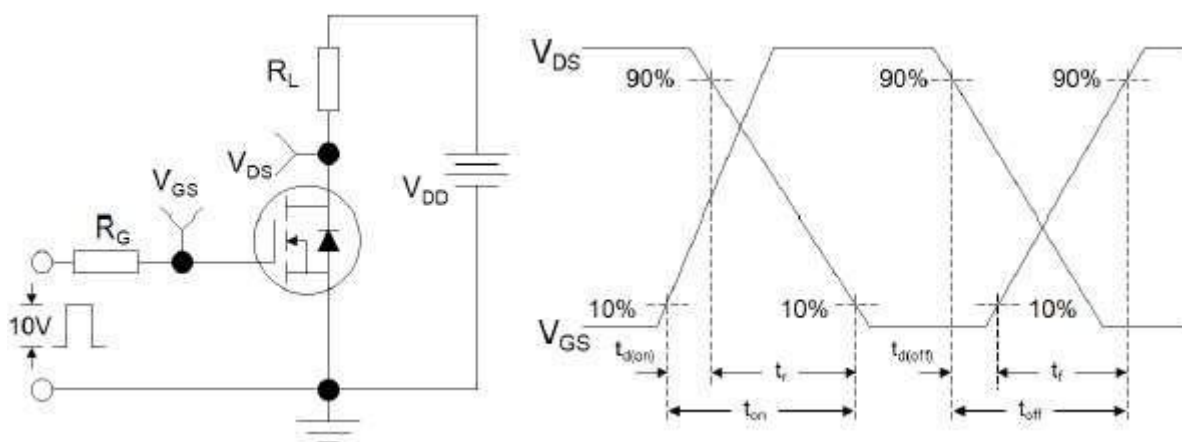


Figure 2: Resistive Switching Test Circuit & Waveforms

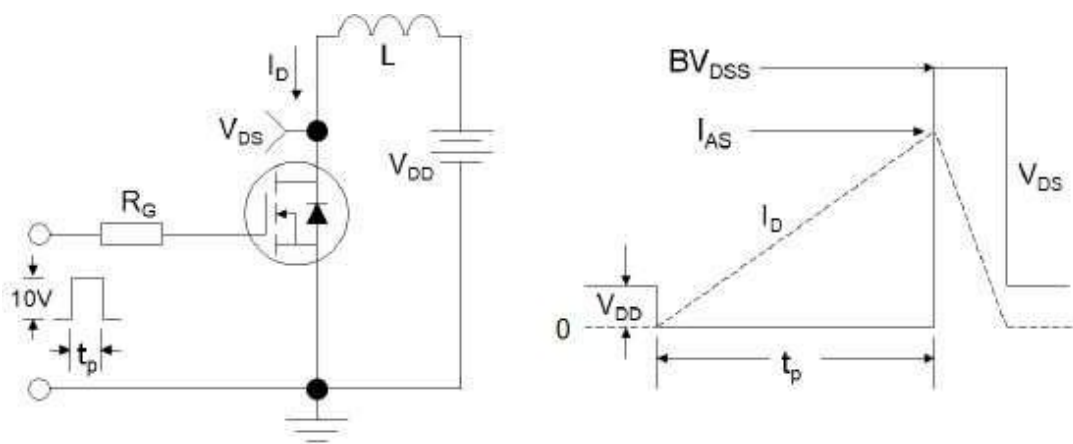
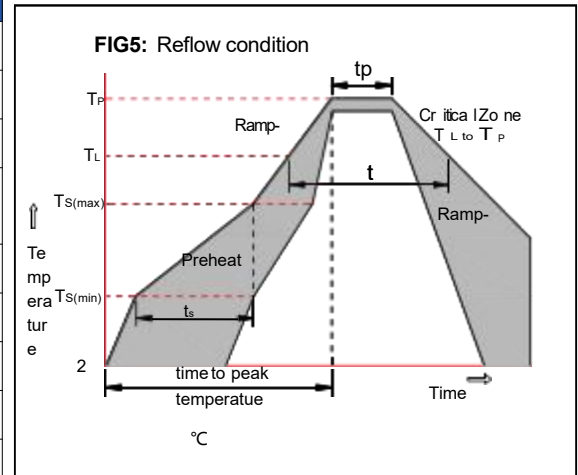


Figure 3:Unclamped Inductive Switching Test Circuit & Waveforms

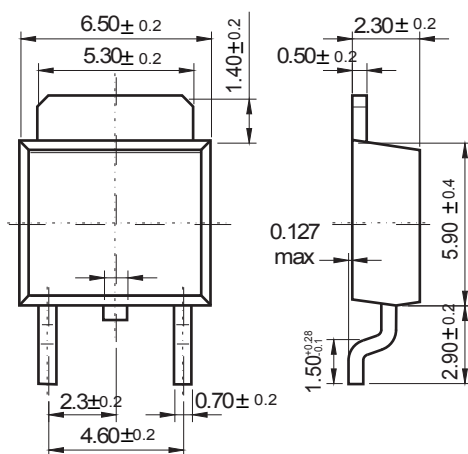
## Soldering parameters

| Reflow Condition                                        |                                   | Pb-Free assembly<br>(see as below) |
|---------------------------------------------------------|-----------------------------------|------------------------------------|
| Pre Heat                                                | -Temperature Min ( $T_{s(min)}$ ) | +150 °C                            |
|                                                         | -Temperature Max( $T_{s(max)}$ )  | +200 °C                            |
|                                                         | -Time (Min to Max) (ts)           | 60-180 secs.                       |
| Average ramp up rate (Liquid us Temp ( $T_L$ ) to peak) |                                   | 3 °C/sec. Max                      |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate                    |                                   | 3 °C/sec. Max                      |
| Reflow                                                  | -Temperature( $T_L$ )(Liquid us)  | +217 °C                            |
|                                                         | -Temperature( $t_L$ )             | 60-150 secs.                       |
| Peak Temp ( $T_P$ )                                     |                                   | +260(+0/-5) °C                     |
| Time within 5 °C of actual Peak Temp ( $t_p$ )          |                                   | 30 secs. Max                       |
| Ramp-down Rate                                          |                                   | 6 °C/sec. Max                      |
| Time 25 °C to Peak Temp ( $T_P$ )                       |                                   | 8 min. Max                         |
| Do not exceed                                           |                                   | +260 °C                            |

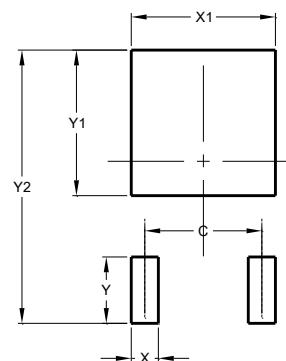


## Package Dimensions & Suggested Pad Layout

### TO-252



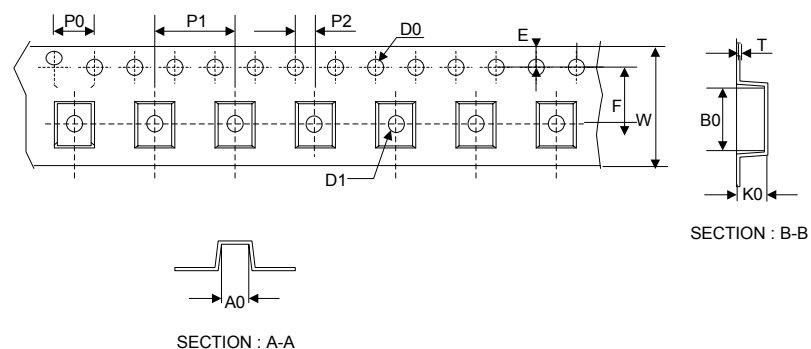
Dimensions in inches and (millimeters)



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 4.55          |
| X          | 1.50          |
| X1         | 5.80          |
| Y          | 2.70          |
| Y1         | 6.00          |
| Y2         | 10.90         |

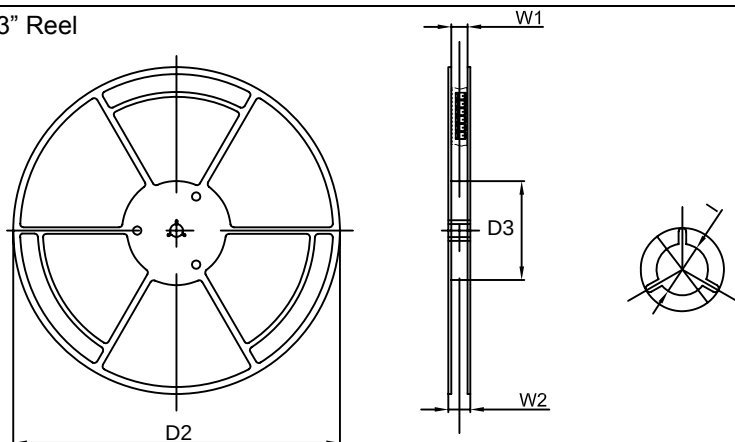
## Tape & rell specification

### Tape



| Symbol | Dimension (mm) |
|--------|----------------|
| P0     | 4.00±0.20      |
| P1     | 8.00±0.20      |
| P2     | 2.00±0.20      |
| D0     | 1.55±0.15      |
| D1     | 1.55±0.20      |
| E      | 1.75±0.20      |
| F      | 7.50±0.20      |
| W      | 16.00±0.20     |
| A0     | 7.10±0.20      |
| B0     | 10.50±0.20     |
| K0     | 2.70±0.20      |
| T      | 0.30±0.10      |
| D2     | 330.0±5.0      |
| D3     | 100.0±4.0      |
| W1     | 20.0±5.0       |
| W2     | 25.0±5.0       |
| I      | 13.0±2.0       |

### 13" Reel



Quantity: 2500PCS