



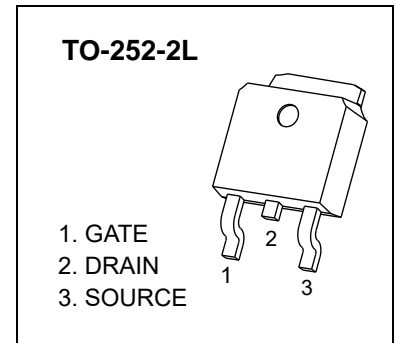
## TO-252-2L Plastic-Encapsulate MOSFETS

### 02N60M1 N-Channel Power MOSFET

$V_{(BR)DSS}$	$R_{DS(on)MAX}$	$I_D$
600V	2.7Ω@10V	2A

#### General Description

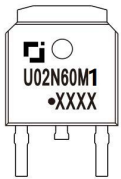
The high voltage MOSFET uses an advanced termination scheme to provide enhanced voltage-blocking capability without degrading performance over time. In addition, this advanced MOSFET is designed to withstand high energy in avalanche and commutation modes. The new energy efficient design also offers a drain-to-source diode with a fast recovery time. Designed for high voltage, high speed switching applications in power suppliers, converters and PWM motor controls, these devices are particularly well suited for bridge circuits where diode speed and commutating safe operating areas are critical and offer additional and safety margin against unexpected voltage transients.



#### FEATURES

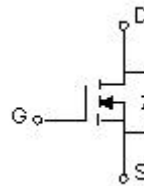
- Robust High Voltage Termination
- Avalanche Energy Specified
- Source-to-Drain Diode Recovery Time Comparable to a Discrete Fast Recovery Diode
- Diode is Characterized for Use in Bridge Circuits
- $I_{DSS}$  and  $V_{DS(on)}$  Specified at Elevated Temperature

#### MARKING



U02N60M1= Device code  
 Solid dot = Green molding compound device,  
 if none, the normal device  
 XXXX=Code

#### EQUIVALENT CIRCUIT



#### Maximum ratings ( $T_a=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	600	V
Gate-Source Voltage	$V_{GS}$	±30	
Continuous Drain Current	$I_D^{(1)}$	2	A
Pulsed Drain Current	$I_{DM}^{(2)}$	8	
Single Pulsed Avalanche Energy	$E_{AS}^{(3)}$	88	mJ
Power Dissipation	$P_D^{(1)}$	62.5	W
Thermal Resistance from Junction to Ambient	$R_{\theta JA}^{(6)}$	75	$^\circ\text{C}/\text{W}$
Thermal Resistance from Junction to Case	$R_{\theta JC}^{(1)}$	2	$^\circ\text{C}/\text{W}$
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 ~+150	$^\circ\text{C}$

# MOSFET ELECTRICAL CHARACTERISTICS

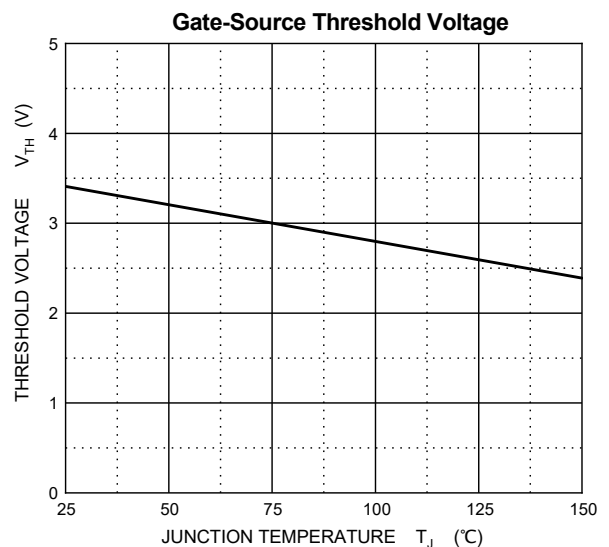
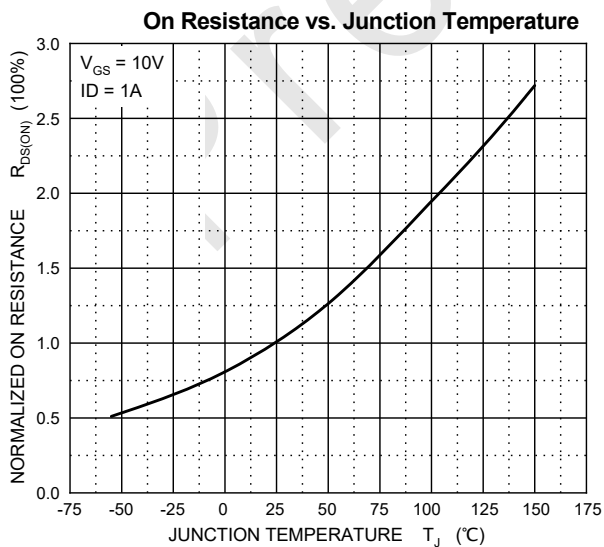
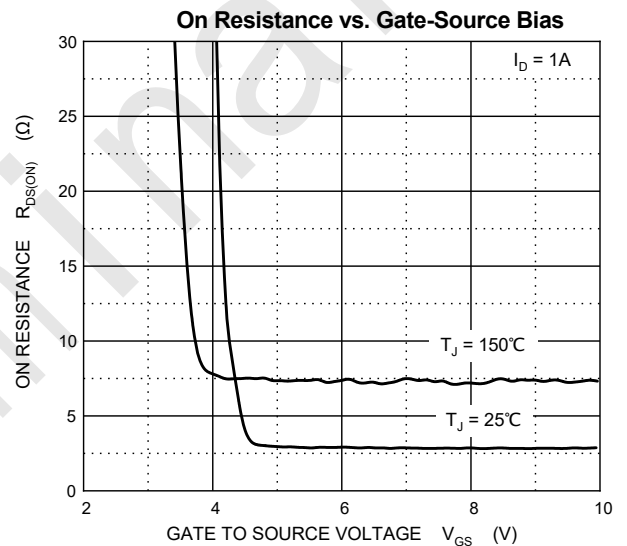
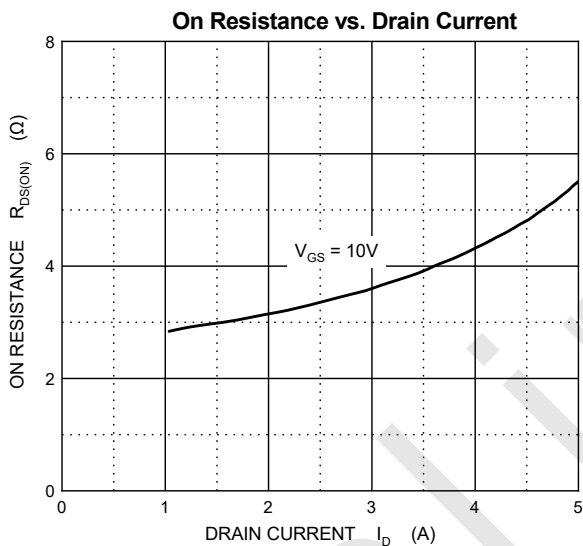
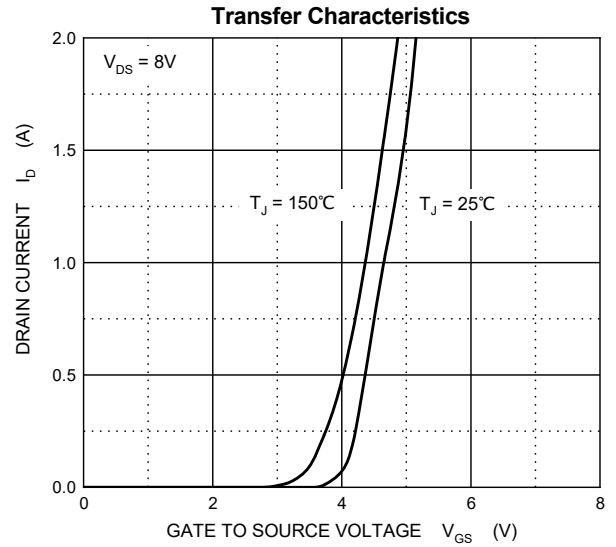
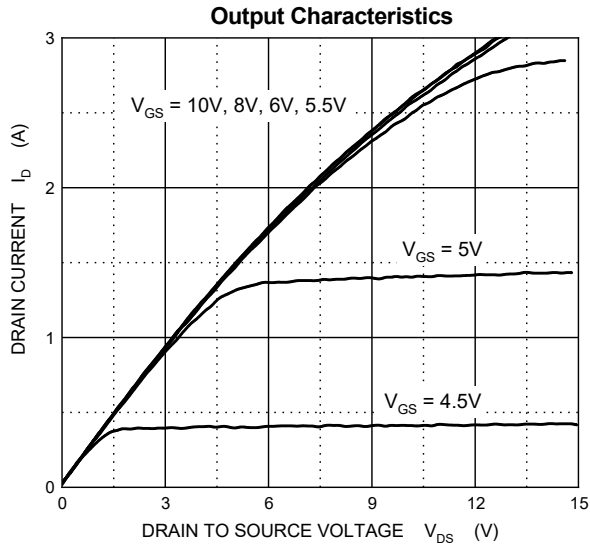
$T_J = 25^\circ\text{C}$  unless otherwise specified

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>Off characteristics</b>						
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=250\mu A$	600			V
Zero gate voltage drain current	$I_{DSS}$	$V_{DS}=600V, V_{GS}=0V$			1.0	$\mu A$
Gate-body leakage current	$I_{GSS}$	$V_{DS}=0V, V_{GS}=\pm 30V$			$\pm 100$	nA
<b>On characteristics</b> <sup>④</sup>						
Gate-threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	2.0	3.4	4.0	V
Static drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=1A$		2.7	3.7	$\Omega$
<b>Dynamic characteristics</b> <sup>⑤</sup>						
Input capacitance	$C_{iss}$	$V_{DS}=25V, V_{GS}=0V,$ $f=1MHz$		322		pF
Output capacitance	$C_{oss}$			38		
Reverse transfer capacitance	$C_{rss}$			7		
Gate resistance	$R_g$	$f=1MHz$		5.7		$\Omega$
<b>Switching characteristics</b> <sup>⑤</sup>						
Total gate charge	$Q_g$	$V_{GS}=10V,$ $V_{DS}=25V, I_D=2A$		1.6		nC
Gate-source charge	$Q_{gs}$			2.1		
Gate-drain charge	$Q_{gd}$			6.2		
Turn-on delay time	$t_{d(on)}$	$V_{DD}=25V, V_{GS}=10V,$ $R_G=18\Omega, I_D=2A$		1.8		nS
Turn-on rise time	$t_r$			3.2		
Turn-off delay time	$t_{d(off)}$			7.4		
Turn-off fall time	$t_f$			7.6		
<b>Drain-Source Diode Characteristics</b>						
Drain-source diode forward voltage	$V_{SD}$ <sup>④</sup>	$V_{GS}=0V, I_S=2A$			898	mV
Continuous drain-source diode forward current	$I_S$ <sup>①</sup>				2.0	A
Pulsed drain-source diode forward current	$I_{SM}$ <sup>②</sup>				8.0	A

Notes:

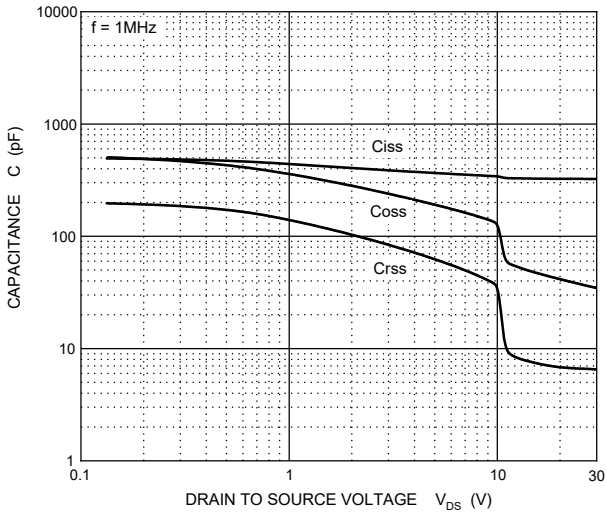
- $T_C=25^\circ\text{C}$  Limited only by maximum temperature allowed.
- $P_W \leq 10\mu s$ , Duty cycle  $\leq 1\%$ .
- EAS condition:  $V_{DD}=150V, V_{GS}=10V, L=10mH, R_g=25\Omega$  Starting  $T_J = 25^\circ\text{C}$ .
- Pulse Test : Pulse Width  $\leq 300\mu s$ , duty cycle  $\leq 2\%$ .
- Guaranteed by design, not subject to production.
- The value of  $R_{\theta JA}$  is measured with the device in a still air environment with  $T_A=25^\circ\text{C}$ .

# Typical Characteristics

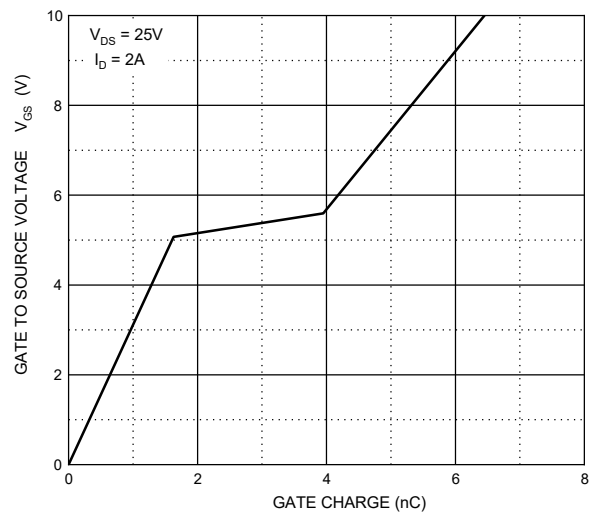


# Typical Characteristics

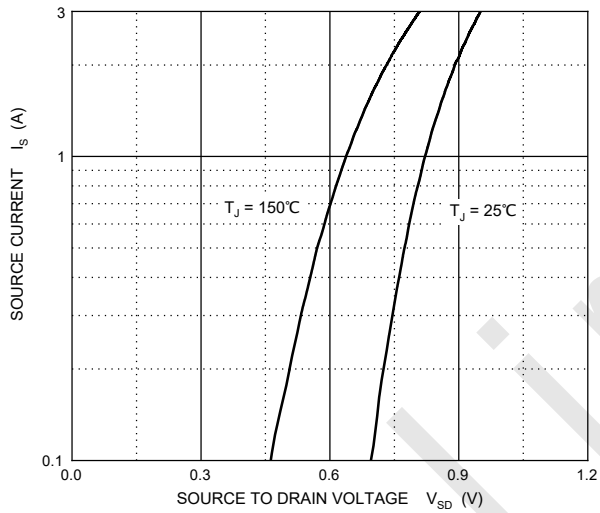
Typical Capacitances



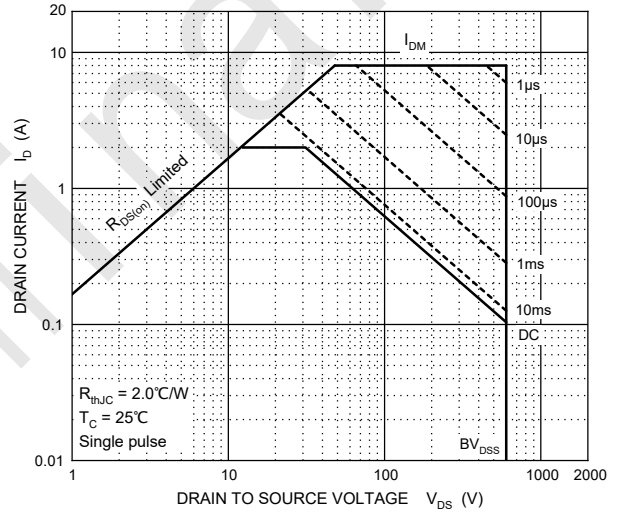
Gate Charge



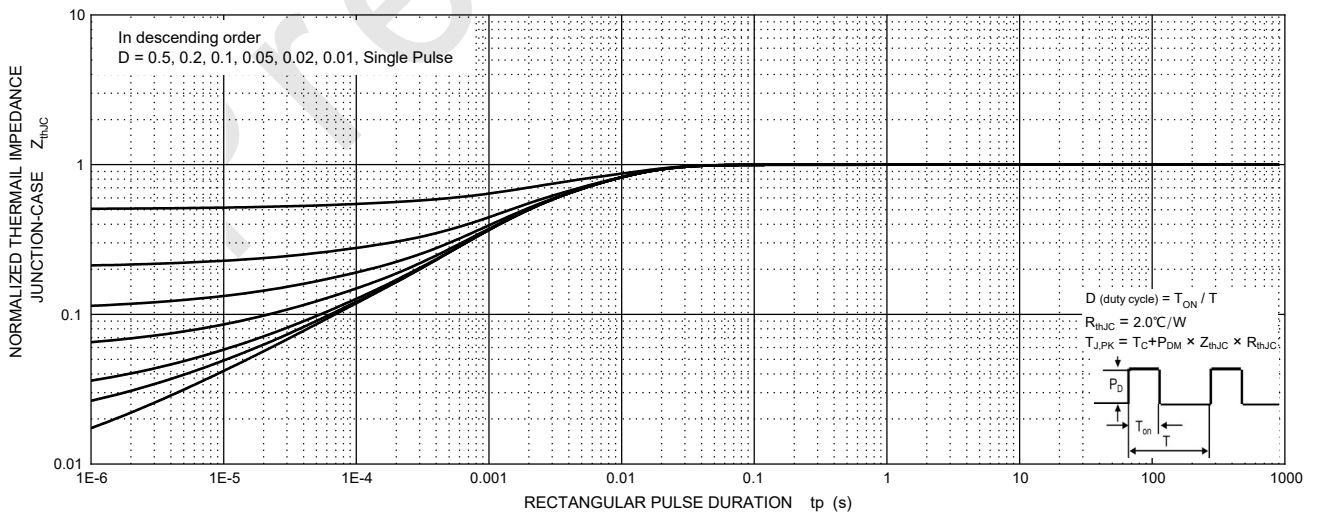
Source-Drain Diode Forward Characteristics



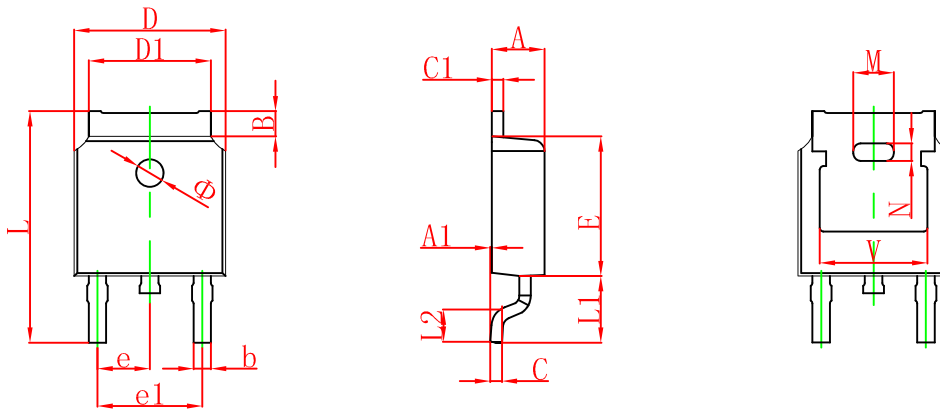
Maximum Safe Operating Area



Transient Thermal Impedance, Junction-Case

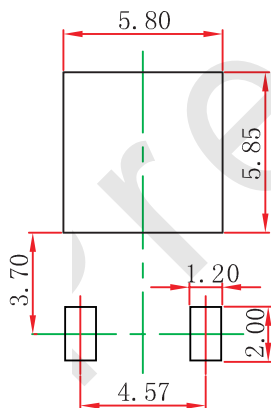


## TO-252(4R)-2L Package Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.380	0.087	0.094
A1	0.000	0.100	0.000	0.004
B	0.800	1.400	0.031	0.055
b	0.710	0.810	0.028	0.032
c	0.460	0.560	0.018	0.022
c1	0.460	0.560	0.018	0.022
D	6.500	6.700	0.256	0.264
D1	5.130	5.460	0.202	0.215
E	6.000	6.200	0.236	0.244
e	2.286 TYP.		0.090 TYP.	
e1	4.327	4.727	0.170	0.186
M	1.778REF.		0.070REF.	
N	0.762REF.		0.018REF.	
L	9.800	10.400	0.386	0.409
L1	2.9REF.		0.114REF.	
L2	1.400	1.700	0.055	0.067
V	4.830 REF.		0.190 REF.	
Φ	1.100	1.300	0.043	0.051

## TO-252(4R)-2L Suggested Pad Layout

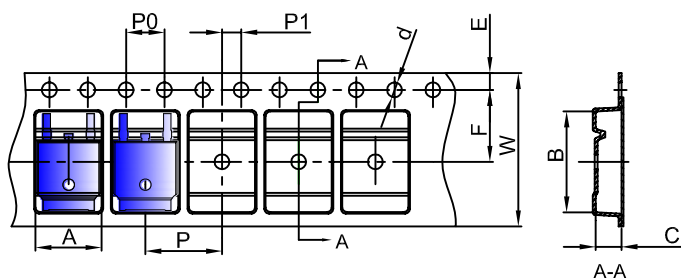


### Note:

1. Controlling dimension: in millimeters.
2. General tolerance:  $\pm 0.05$  mm.
3. The pad layout is for reference purposes only.

# To-252(4R)-2L Tape and Reel

## TO-252 Embossed Carrier Tape

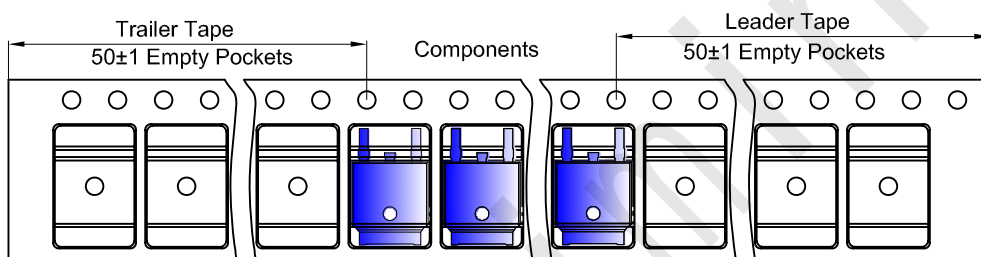


### Packaging Description:

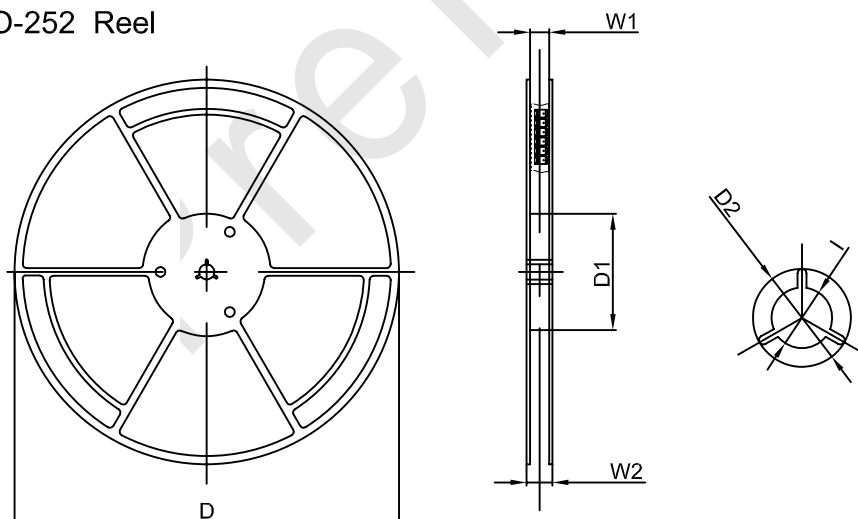
TO-252 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 25,00 units per 13" or 33.0 cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

Dimensions are in millimeter										
Pkg type	A	B	C	d	E	F	P0	P	P1	W
TO-252	6.90	10.50	2.70	Ø1.55	1.75	7.50	4.00	8.00	2.00	16.00
(Tolerance)	+/-0.1	+/-0.1	+/-0.1	+/-0.1	+/-0.1	+/-0.1	+/-0.1	+/-0.1	+/-0.1	+0.3/-0.1

## TO-252 Tape Leader and Trailer



## TO-252 Reel



Dimensions are in millimeter						
Reel Option	D	D1	D2	W1	W2	I
13" Dia	330.00	100.00	Ø21.00	16.40	21.00	Ø13.00
Tolerance	+/-2	+/-1	+/-1	+/-1	+/-1	+/-1

REEL	Reel Size	Box	Box Size(mm)	Carton	Carton Size(mm)	G.W.(kg)
2,500 pcs	13inch	2,500 pcs	340×336×29	25,000 pcs	353×346×365	14.04