

## Product Summary

$V_{CE}$	$V_{CE(sat)}$	$I_c(T_c=100^\circ C)$
650V	1.8V	10A



合肥矽普半导体

Siliup Semiconductor Technology Co., Ltd

技术 品质 服务

www.siliup.com

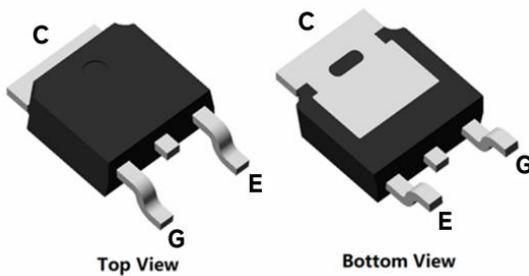
## Feature

- High ruggedness performance
- 10 $\mu$ s short circuit capability
- Positive  $V_{CE(sat)}$  temperature coefficient
- High efficiency for motor control
- Excellent current sharing in parallel operation

## Applications

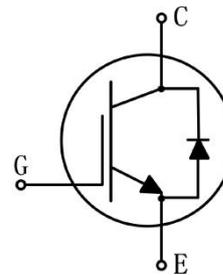
- Home appliances
- Motor drives

## Package

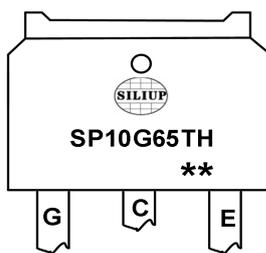


TO-252(1:G 2:C 3:E)

## Circuit diagram



## Marking



SP10G65TH :Device Code  
\*\* :Week Code

## Order Information

Device	Package	Unit/Tape
SP10G65TH	TO-252	2500

## Maximum ratings

Symbol	Parameter	Values	Unit
$V_{CES}$	Collector-emitter voltage	650	V
$V_{GES}$	Gate-emitter voltage	$\pm 20$	V
$I_C$	Continuous collector current ( $T_C=25^\circ\text{C}$ )	20	A
	Continuous collector current ( $T_C=100^\circ\text{C}$ )	10	A
$I_{CM}$	Pulsed collector current, $t_p$ limited by $T_{vjmax}$	40	A
$I_F$	Diode continuous forward current ( $T_C=100^\circ\text{C}$ )	10	A
$I_{FM}$	Diode maximum current, $t_p$ limited by $T_{vjmax}$	40	A
$t_{sc}$	Short circuit withstand time	10	$\mu\text{s}$
$P_{tot}$	Power dissipation ( $T_C=25^\circ\text{C}$ )	75	W
	Power dissipation ( $T_C=100^\circ\text{C}$ )	38	W
$T_{vj}$	Operating junction temperature range	-40 to +175	$^\circ\text{C}$
$T_{stg}$	Storage temperature range	-55 to +150	$^\circ\text{C}$

## Thermal characteristics

Symbol	Parameter	Values		Unit
		Typ.	Max.	
$R_{th(j-c)}$	Thermal resistance, junction to case for IGBT	-	2.0	K/W
$R_{th(j-c)}$	Thermal resistance, junction to case for Diode	-	2.2	K/W
$R_{th(j-a)}$	Thermal resistance, junction to ambient	-	90	K/W

**Electrical characteristics of IGBT ( $T_{vj}=25^{\circ}\text{C}$  unless otherwise specified)**
**Static characteristics**

Symbol	Parameter	Test condition	Values			Unit
			Min.	Typ.	Max.	
$BV_{CES}$	Collector-emitter breakdown voltage	$V_{GE}=0V, I_C=250\mu A$	650	-	-	V
$I_{CES}$	Collector-emitter leakage current	$V_{CE}=650V, V_{GE}=0V$	-	-	50	$\mu A$
$I_{GES}$	Gate leakage current, forward	$V_{GE}=20V, V_{CE}=0V$	-	-	100	nA
	Gate leakage current, reverse	$V_{GE}=-20V, V_{CE}=0V$	-	-	-100	nA
$V_{GE(th)}$	Gate-emitter threshold voltage	$V_{GE}=V_{CE}, I_C=1mA$	5.3	5.8	6.3	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}=15V, I_C=10A$	-	1.8	-	V
		$V_{GE}=15V, I_C=10A, T_{vj}=175^{\circ}\text{C}$	-	2.3	-	V

**Dynamic characteristics**

Symbol	Parameter	Test condition	Values			Unit
			Min.	Typ.	Max.	
$C_{ies}$	Input capacitance	$V_{CE}=30V$ $V_{GE}=0V$ $f=1MHz$	-	670	-	pF
$C_{oes}$	Output capacitance		-	37	-	pF
$C_{res}$	Reverse transfer capacitance		-	10	-	pF
$Q_g$	Total gate charge	$V_{CC}=520V$ $V_{GE}=15V$ $I_C=10A$	-	28	-	nC

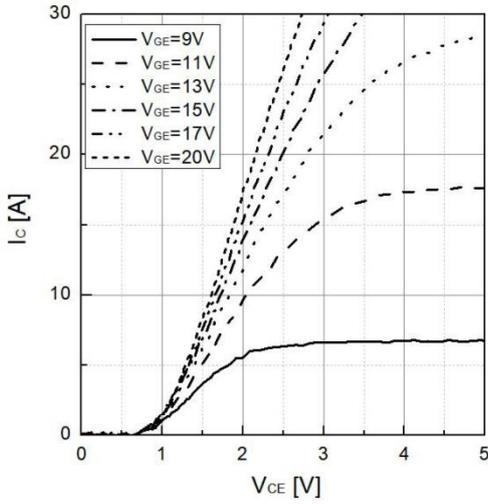
**Switching characteristics**

Symbol	Parameter	Test condition	Values			Unit
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=400V$ $V_{GE}=0/15V$ $I_C=10A$ $R_G=10\Omega$ Inductive load	-	12	-	ns
$t_r$	Rise time		-	11	-	ns
$t_{d(off)}$	Turn-off delay time		-	74	-	ns
$t_f$	Fall time		-	71	-	ns
$E_{on}$	Turn-on energy		-	0.18	-	mJ
$E_{off}$	Turn-off energy		-	0.17	-	mJ
$E_{ts}$	Total switching energy		-	0.35	-	mJ
$t_{d(on)}$	Turn-on delay time	$V_{CC}=400V$ $V_{GE}=0/15V$ $I_C=10A$ $R_G=10\Omega$ Inductive load $T_{vj}=175^\circ C$	-	11	-	ns
$t_r$	Rise time		-	13	-	ns
$t_{d(off)}$	Turn-off delay time		-	114	-	ns
$t_f$	Fall time		-	87	-	ns
$E_{on}$	Turn-on energy		-	0.22	-	mJ
$E_{off}$	Turn-off energy		-	0.27	-	mJ
$E_{ts}$	Total switching energy		-	0.49	-	mJ

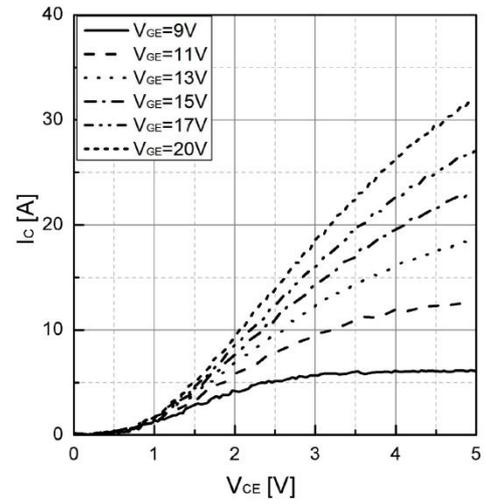
**Electrical characteristics of Diode ( $T_{vj}=25^{\circ}\text{C}$  unless otherwise specified)**

Symbol	Parameter	Test condition	Values			Unit
			Min.	Typ.	Max.	
$V_F$	Diode forward voltage	$I_F=10\text{A}$	-	1.4	-	V
		$I_F=10\text{A}$ , $T_{vj}=175^{\circ}\text{C}$	-	1.2	-	V
$t_{rr}$	Diode reverse recovery time	$V_R=400\text{V}$ $I_F=10\text{A}$ $di_F/dt=-750\text{A}/\mu\text{s}$	-	57	-	ns
$I_{rrm}$	Diode peak reverse recovery current		-	12	-	A
$Q_{rr}$	Diode reverse recovery charge		-	411	-	nC
$t_{rr}$	Diode reverse recovery time	$V_R=400\text{V}$ $I_F=10\text{A}$ $di_F/dt=-750\text{A}/\mu\text{s}$ $T_{vj}=175^{\circ}\text{C}$	-	124	-	ns
$I_{rrm}$	Diode peak reverse recovery current		-	13	-	A
$Q_{rr}$	Diode reverse recovery charge		-	737	-	nC

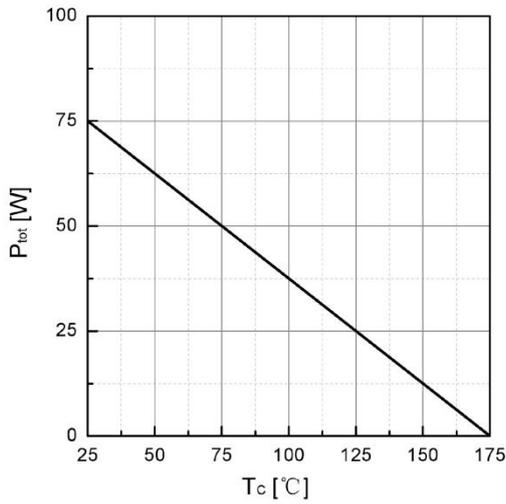
## Typical performance characteristics



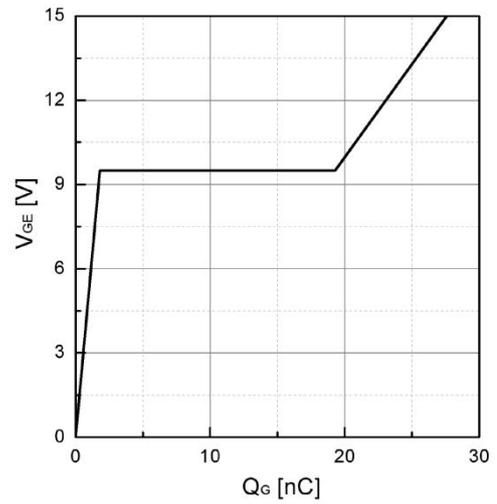
Typical output characteristic ( $T_{vj}=25^{\circ}\text{C}$ )



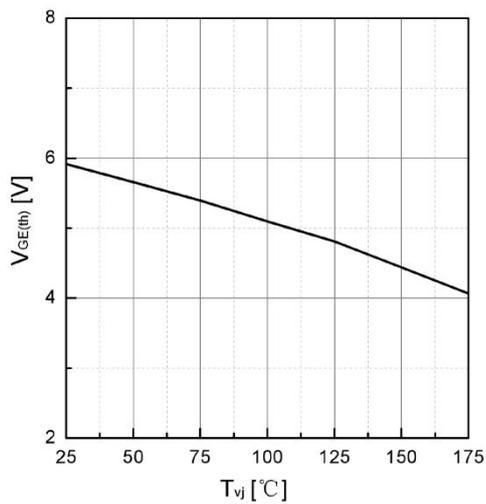
Typical output characteristic ( $T_{vj}=175^{\circ}\text{C}$ )



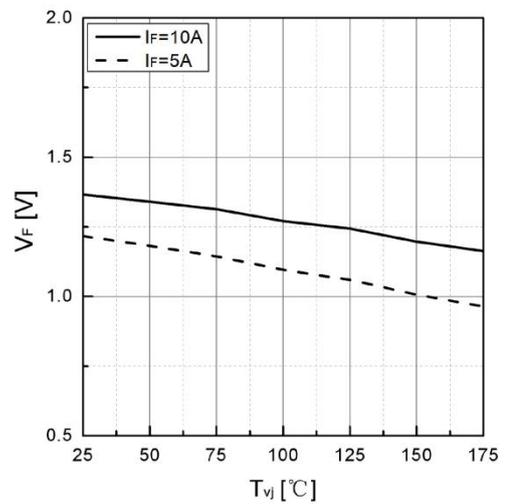
Power dissipation as a function of  $T_c$



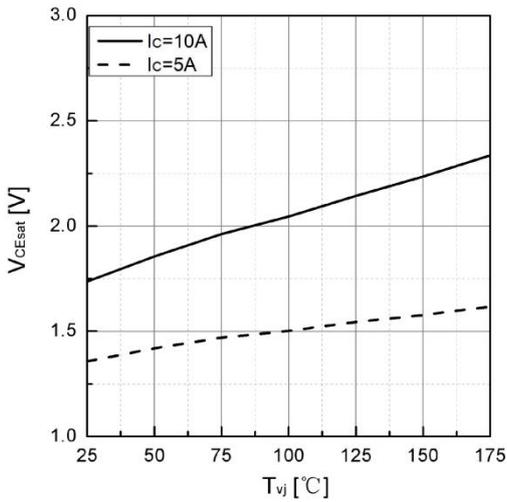
Typical Gate charge



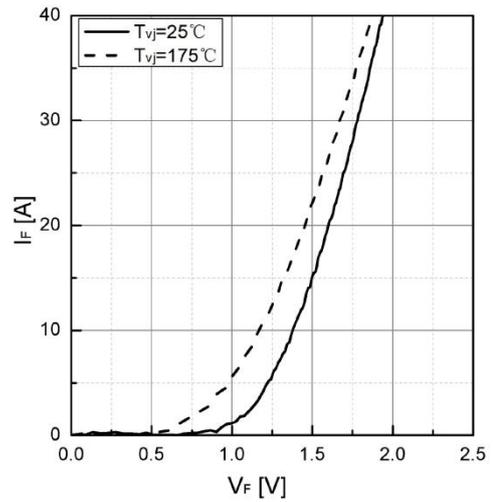
Typical  $V_{GE(th)}$  as a function of  $T_{vj}$   
( $I_c=1\text{mA}$ )



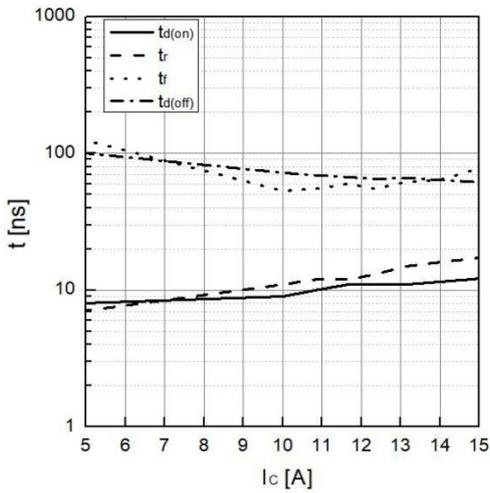
Typical  $V_F$  as a function of  $T_{vj}$



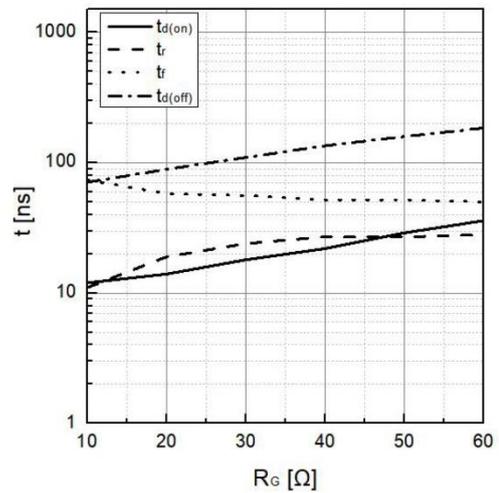
Typical  $V_{CEsat}$  as a function of  $T_{vj}$



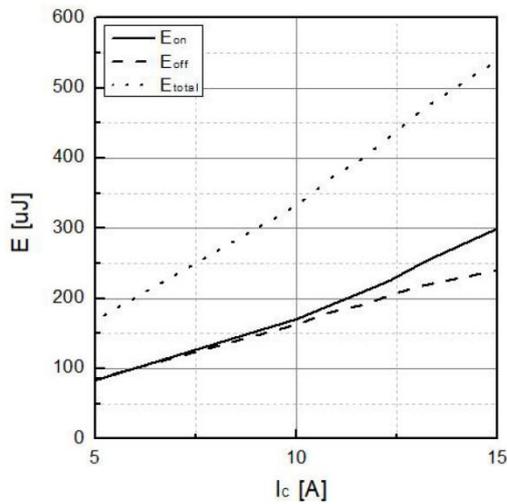
Typical  $I_F$  as a function of  $V_F$



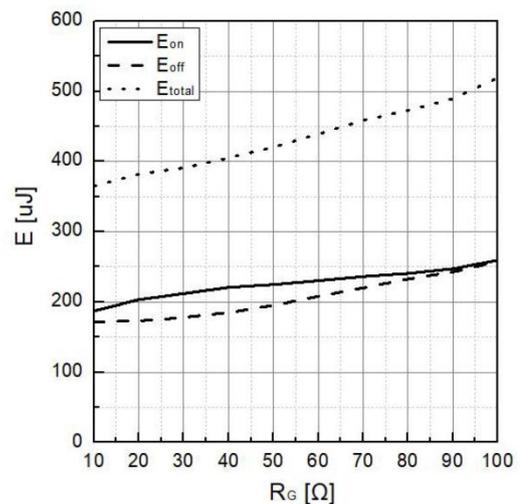
Typical switching time as a function of  $I_c$



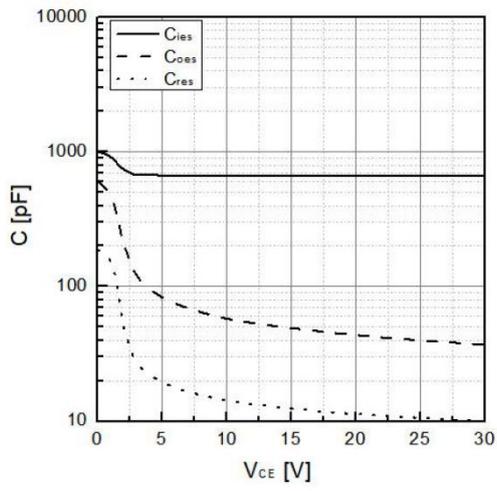
Typical switching times as a function of  $R_G$



Typical switching energy losses as a function of  $I_c$

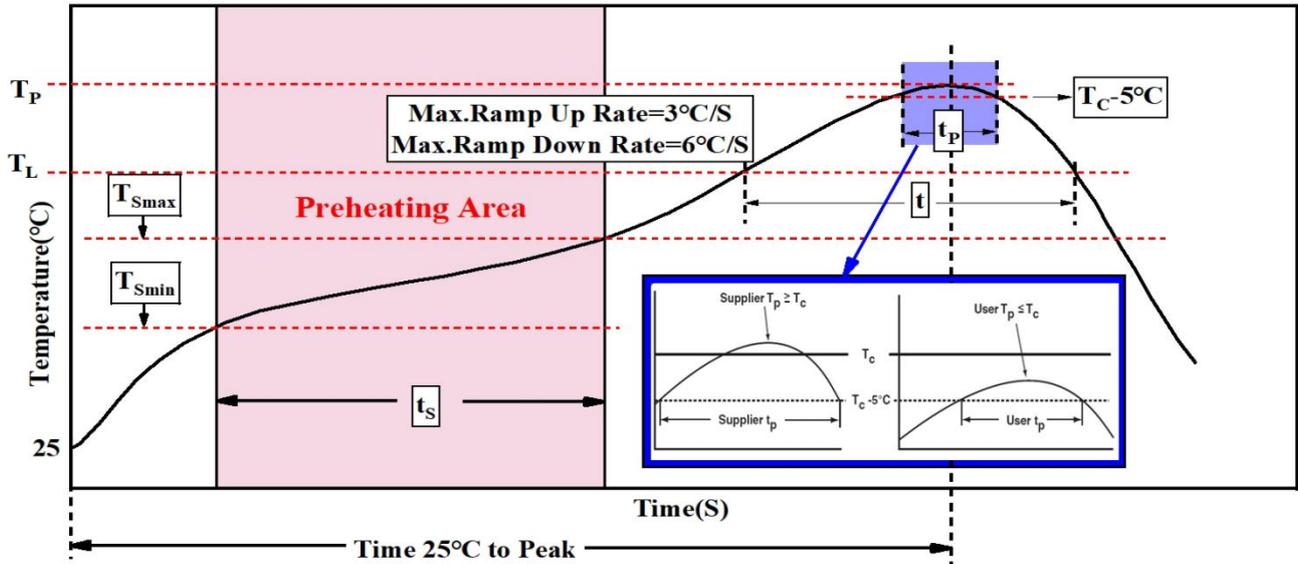


Typical switching energy losses as a function of  $R_G$



Typical capacitance as a function of V<sub>CE</sub>  
(f=1Mhz, V<sub>GE</sub>=0V)

## Temperature Profile for IR Reflow Soldering



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
<b>Preheat &amp; Soak</b>		
Temperature min (T <sub>smin</sub> )	100°C	150°C
Temperature max (T <sub>smax</sub> )	150°C	200°C
Time (T <sub>smin</sub> to T <sub>smax</sub> ) (t <sub>s</sub> )	60-120 seconds	60-120 seconds
Average ramp-up rate (T <sub>smax</sub> to T <sub>p</sub> )	3 °C/second max.	3°C/second max.
Liquidous temperature (TL)	183 °C	217°C
Time at liquidous (t <sub>L</sub> )	60-150 seconds	60-150 seconds
Peak package body Temperature e (T <sub>p</sub> )*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t <sub>p</sub> )** within 5°C of the specified classification temperature (T <sub>c</sub> )	20** seconds	30** seconds
Average ramp-down rate (T <sub>p</sub> to T <sub>smax</sub> )	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
* Tolerance for peak profile Temperature (T <sub>p</sub> ) is defined as a supplier minimum and a user maximum. ** Tolerance for time at peak profile temperature (t <sub>p</sub> ) is defined as a supplier minimum and a user maximum		

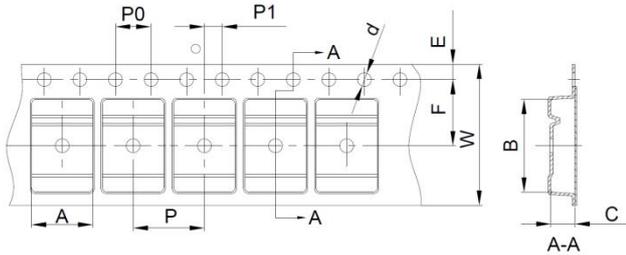
Table 1. SnPb Eutectic Process – Classification Temperatures (T<sub>c</sub>)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2. Pb-free Process – Classification Temperatures (T<sub>c</sub>)

Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350-2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

### TO-252 Embossed Carrier Tape

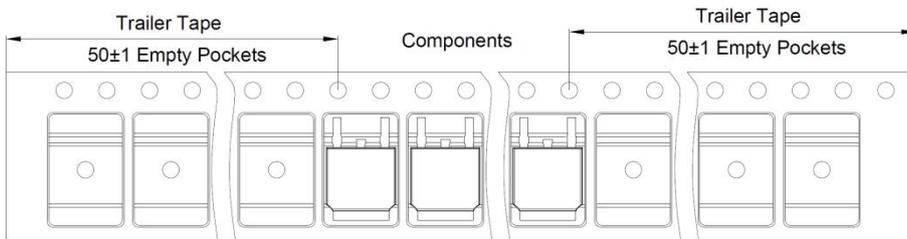


**Packaging Description:**

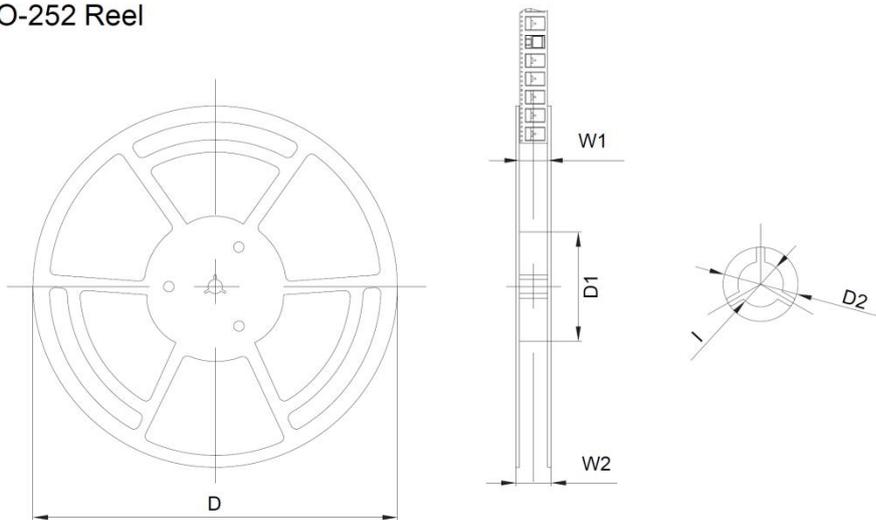
TO-252 parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Hear Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 2500 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	Φ1.55	1.75	7.50	4.00	8.00	2.00	16.00

### TO-252 Tape Leader and Trailer



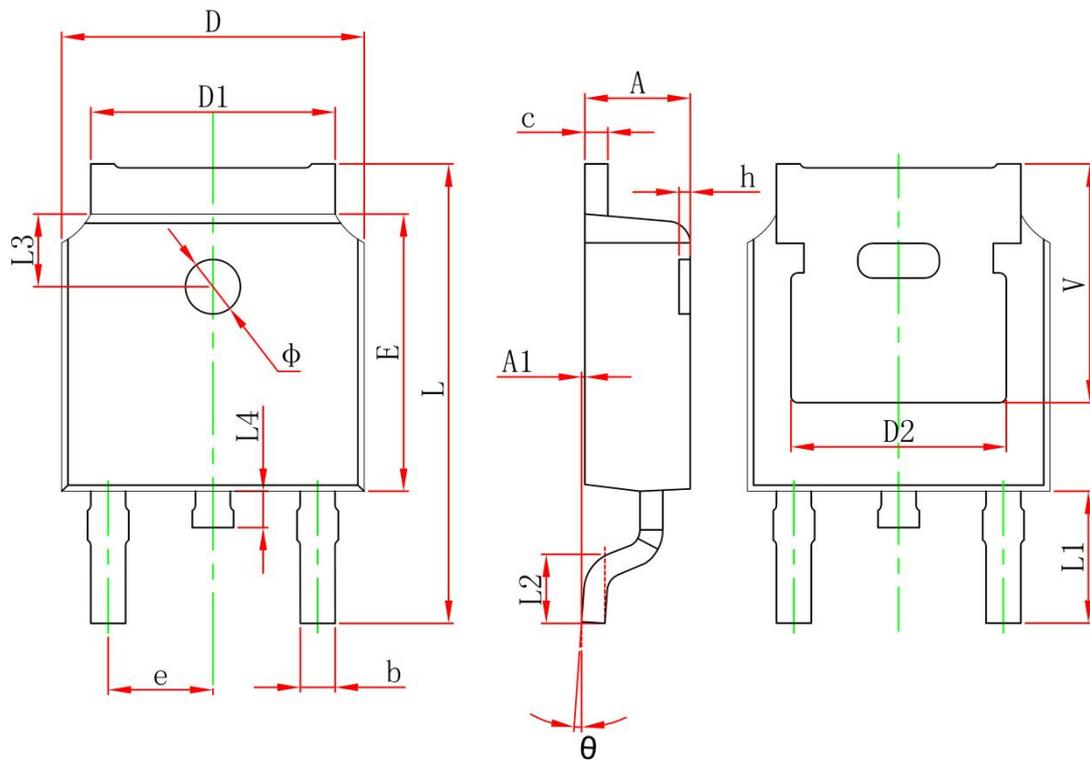
### TO-252 Reel



Dimensions are in millimeter						
Reel	D	D1	D2	W1	W2	I
13" Dia	330.00	100.00	Φ21.00	16.40	21.40	Φ13.00

Reel	Reel Size	Box	Box Size(mm)	Carton	Carton Size(mm)
2500 pcs	13 inch	5000 pcs	360×360×65	25000 pcs	378×358×382

## TO-252 Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 REF.		0.190 REF.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 REF.		0.114 REF.	
L2	1.400	1.700	0.055	0.067
L3	1.600 REF.		0.063 REF.	
L4	0.600	1.000	0.024	0.039
φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 REF.		0.211 REF.	