



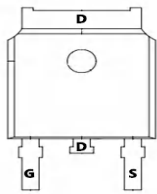
**TM60P04D**

**P-Channel Enhancement Mosfet**

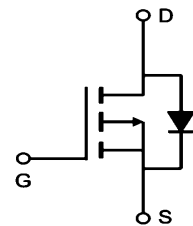
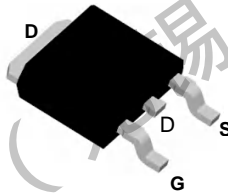
<p><b>General Description</b></p> <ul style="list-style-type: none"> <li>• Low <math>R_{DS(ON)}</math></li> <li>• RoHS and Halogen-Free Compliant</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• Load switch</li> <li>• PWM</li> </ul>	<p><b>General Features</b></p> <p><math>V_{DS} = -40V</math> <math>I_D = -60A</math></p> <p><math>R_{DS(ON)} = 8.3m\Omega</math> (typ.) @ <math>V_{GS} = -10V</math></p> <p>100% UIS Tested 100% <math>R_g</math> Tested</p>
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D:TO-252-3L



Marking: 60P04



**Absolute Maximum Ratings** ( $T_c = 25^\circ C$  Unless Otherwise Noted)

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	-40	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D @ T_c = 25^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-60	A
$I_D @ T_c = 100^\circ C$	Continuous Drain Current, $V_{GS} @ -10V$	-34	A
$I_{DM}$	Pulsed Drain Current	-198	A
EAS	Single Pulse Avalanche Energy	144	mJ
$I_{AS}$	Avalanche Current	-30	A
$P_D @ T_c = 25^\circ C$	Total Power Dissipation	45	W
$T_{STG}$	Storage Temperature Range	-55 to 175	$^\circ C$
$T_J$	Operating Junction Temperature Range	-55 to 175	$^\circ C$

**Thermal Data**

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JA}$	Thermal Resistance Junction-ambient	---	62	$^\circ C/W$
$R_{\theta JC}$	Thermal Resistance Junction-Case	---	6.6	$^\circ C/W$

**TM60P04D**
**P-Channel Enhancement Mosfet**
**Electrical Characteristics** ( $T_J=25^\circ\text{C}$  unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
<b>Off Characteristic</b>						
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D = -250\mu A$	-40	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = -40V, V_{GS}=0V$	-	-	-1	$\mu A$
$I_{GSS}$	Gate to Body Leakage Current	$V_{DS}=0V, V_{GS}= \pm 20V$	-	-	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D = -250\mu A$	-1.4	-1.75	-2.0	V
$R_{DS(on)}$ note3	Static Drain-Source on-Resistance	$V_{GS} = -10V, I_D = -20A$	-	8.3	11	m $\Omega$
		$V_{GS} = -4.5V, I_D = -10A$	-	12	19	
<b>Dynamic Characteristics</b>						
$C_{iss}$	Input Capacitance	$V_{DS} = -20V, V_{GS}=0V,$ $f=1.0MHz$	-	3500	-	pF
$C_{oss}$	Output Capacitance		-	329	-	pF
$C_{rss}$	Reverse Transfer Capacitance		-	289	-	pF
$Q_g$	Total Gate Charge	$V_{DS} = -20V, I_D = -20A,$ $V_{GS} = -10V$	-	-	-	nC
$Q_{gs}$	Gate-Source Charge		-	10	-	nC
$Q_{gd}$	Gate-Drain("Miller") Charge		-	14	-	nC
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-on Delay Time	$V_{DD} = -20V, I_D = -20A,$ $V_{GS} = -10V, R_{GEN}=2.4\Omega$	-	10	-	ns
$t_r$	Turn-on Rise Time		-	82	-	ns
$t_{d(off)}$	Turn-off Delay Time		-	93	-	ns
$t_f$	Turn-off Fall Time		-	74	-	ns
<b>Drain-Source Diode Characteristics and Maximum Ratings</b>						
$I_S$	Maximum Continuous Drain to Source Diode Forward Current		-	-	-60	A
$I_{SM}$	Maximum Pulsed Drain to Source Diode Forward Current		-	-	-160	A
$V_{SD}$	Drain to Source Diode Forward Voltage	$V_{GS}=0V, I_S = -30A$	-	-0.8	-1.2	V
$t_{rr}$	Reverse Recovery Time	$V_{GS}=0V, I_S = -30A,$	-	20	-	ns
$Q_{rr}$	Reverse Recovery Charge	$di/dt=100A/\mu s$	-	13	-	nC



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Typical Performance Characteristics

Figure 1: Output Characteristics

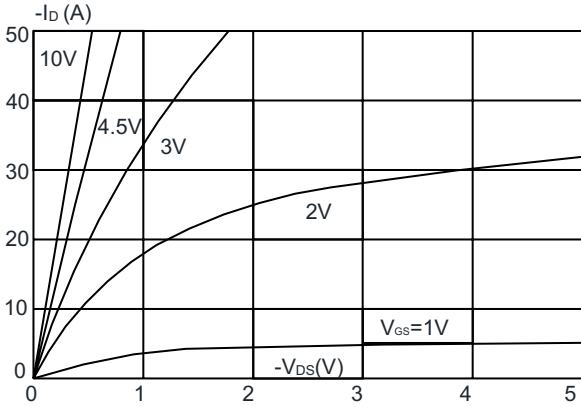


Figure 2: Typical Transfer Characteristics

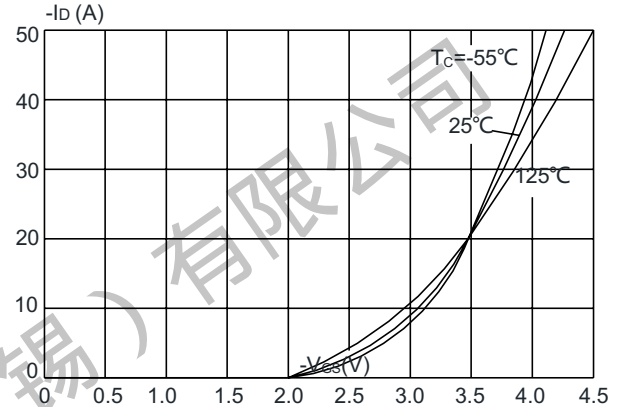


Figure 3: On-resistance vs. Drain Current

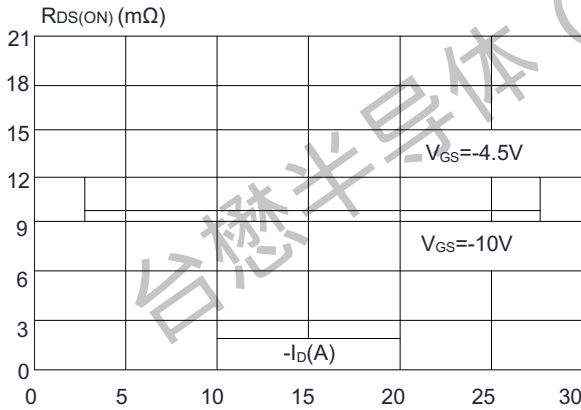


Figure 4: Body Diode Characteristics

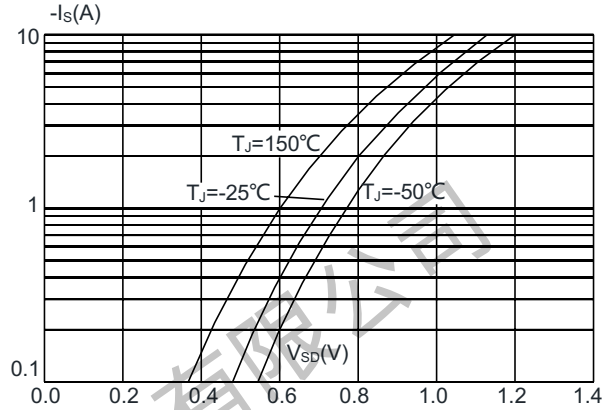


Figure 5: Gate Charge Characteristics

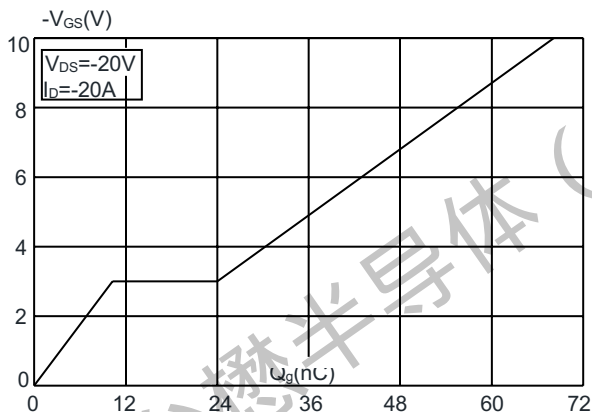
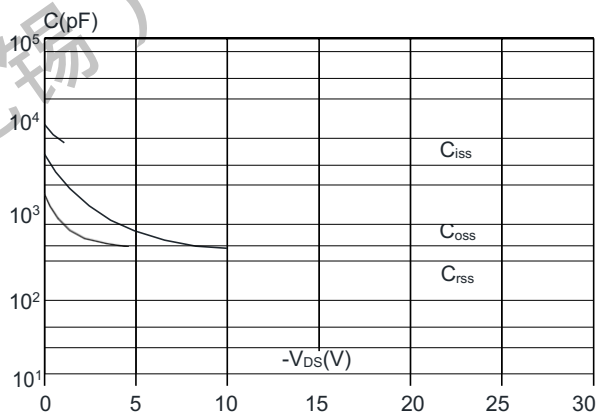


Figure 6: Capacitance Characteristics





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Figure 7: Normalized Breakdown Voltage vs. Junction Temperature

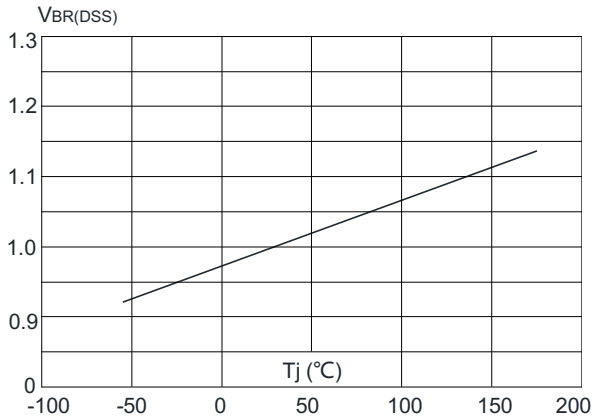


Figure 8: Normalized on Resistance vs. Junction Temperature

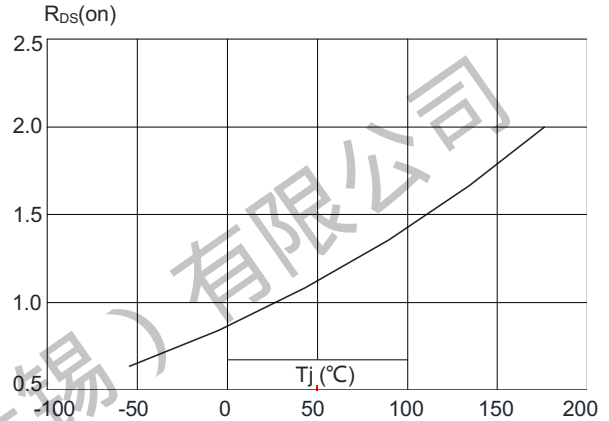


Figure 9: Maximum Safe Operating Area

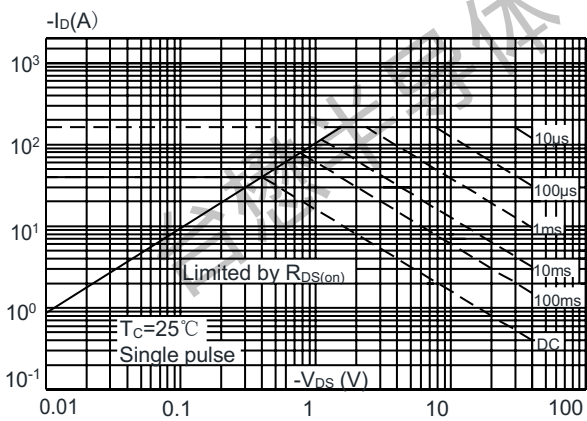


Figure 10: Maximum Continuous Drain Current vs. Case Temperature

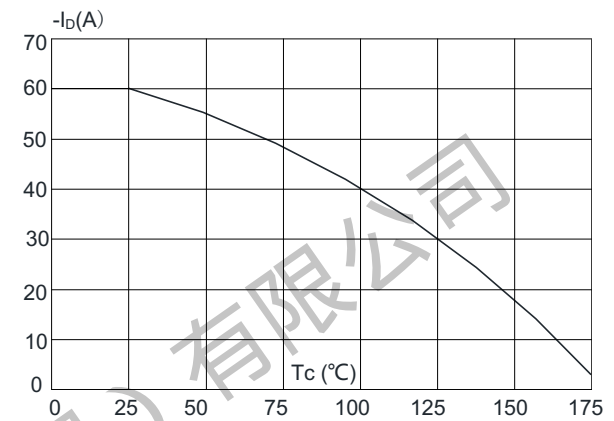
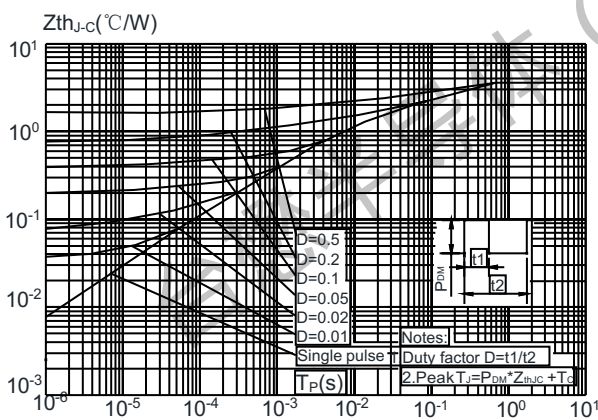


Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Case

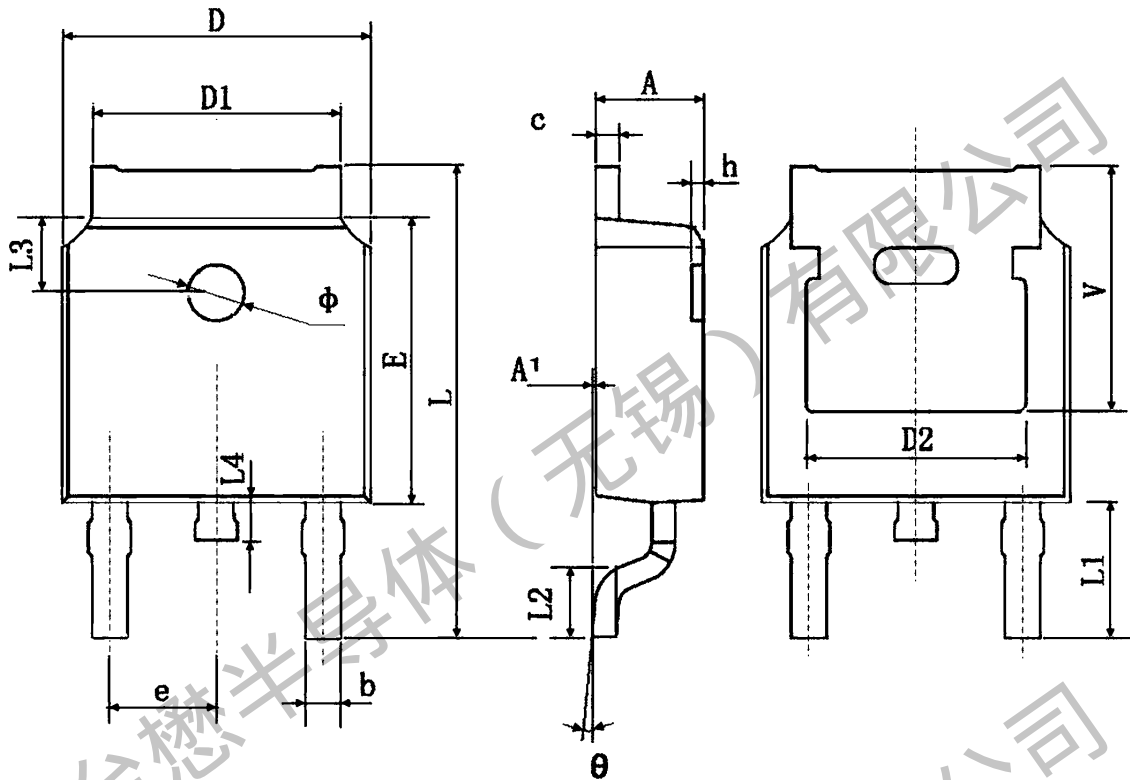




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Package Mechanical Data: TO-252-3L



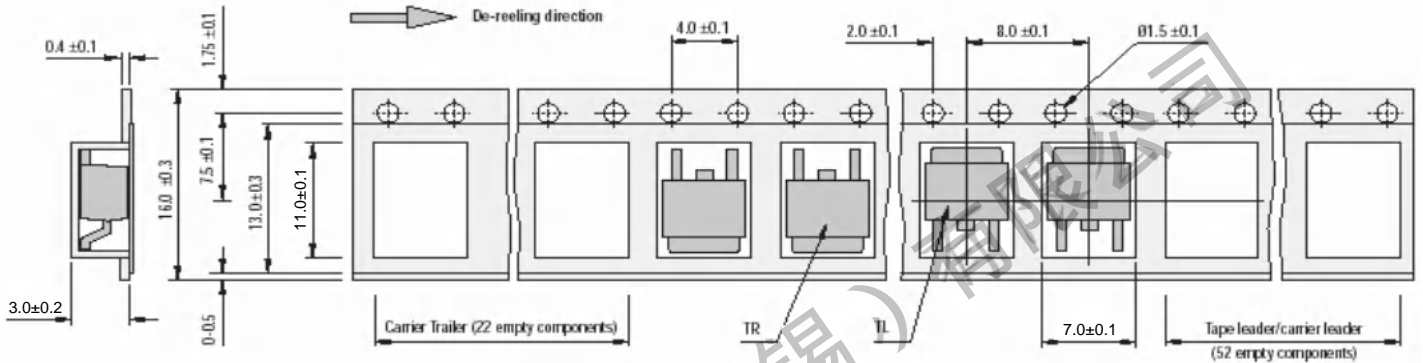
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	4.830 TYP.		0.190 TYP.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 TYP.		0.114 TYP.	
L2	1.400	1.700	0.055	0.067
L3	1.600 TYP.		0.063 TYP.	
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 TYP.		0.211 TYP.	



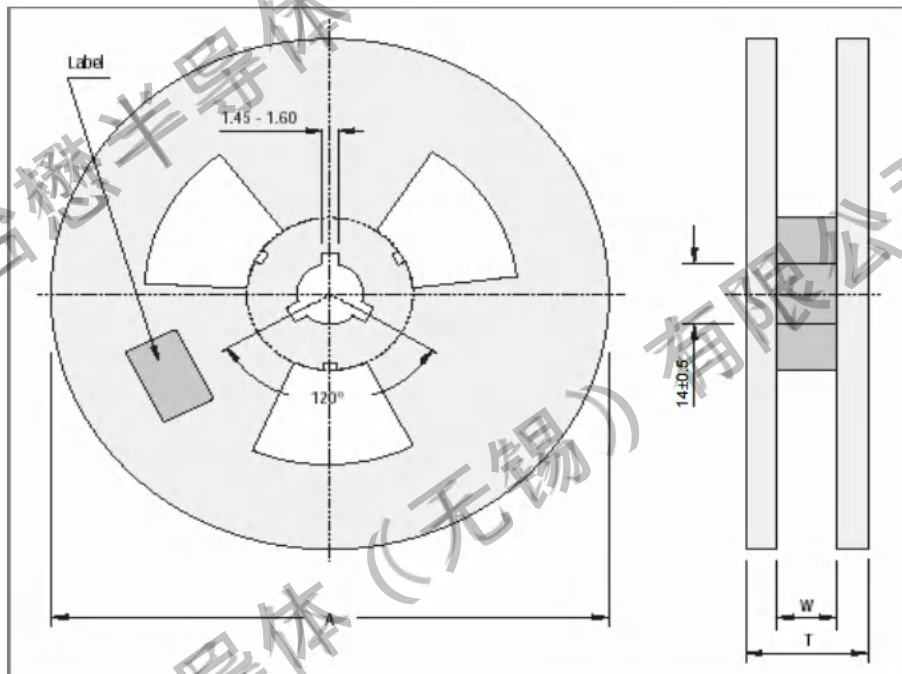
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TO-252-3L Embossed Carrier Tape



TO-252-3L Reel



All Dimensions are in mm

Reel Specifications				
Package	Tape Width	Reel Dia. A - Max	Inside Thickness W	Reel Thickness T - max
TO-252-3L	16	330	18.0 ± 1.5	20

Packaging Information

REEL	Reel Size	Box	Box Size(mm)	Carton	Carton Size(mm)	G.W.(kg)
2,500 pcs	13 inch	5,000 pcs	355×370×50	25,000 pcs	380×275×380	



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Revision history:

Date	Rev	Description	Page
2023.04.08	23.04	Original	