



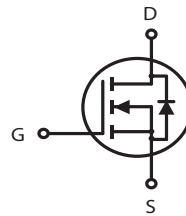
## N-Channel Enhancement Mode Field Effect Transistor

## PRODUCT SUMMARY

V <sub>DS</sub>	I <sub>D</sub>	R <sub>DS(ON)</sub> (m $\Omega$ ) Max
60V	22A	30 @ V <sub>GS</sub> = 10V
		38 @ V <sub>GS</sub> = 4.5V

## FEATURES

- Super high dense cell design for low R<sub>DS(ON)</sub>.
- Rugged and reliable.
- TO-252 and TO-251 Package.

ABSOLUTE MAXIMUM RATINGS (T<sub>A</sub>=25°C unless otherwise noted)

Parameter	Symbol	Limit	Unit	
Drain-Source Voltage	V <sub>DS</sub>	60	V	
Gate-Source Voltage	V <sub>GS</sub>	±20	V	
Drain Current-Continuous <sup>a</sup> @ T <sub>a</sub>	I <sub>D</sub>	25°C	22	A
		70°C	17	A
-Pulsed <sup>b</sup>	I <sub>DM</sub>	60	A	
Drain-Source Diode Forward Current <sup>a</sup>	I <sub>S</sub>	15	A	
Maximum Power Dissipation <sup>a</sup>	P <sub>D</sub>	T <sub>a</sub> =25°C	50	W
		T <sub>a</sub> =70°C	35	
Operating Junction and Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to 175	°C	

## THERMAL CHARACTERISTICS

Thermal Resistance, Junction-to-Case	R $\theta$ JC	3	°C/W
Thermal Resistance, Junction-to-Ambient	R $\theta$ JA	50	°C/W

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N-Channel ELECTRICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$  unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ <sup>c</sup>	Max	Unit
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	60			V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=48V, V_{GS}=0V$			1	$\mu A$
Gate-Body Leakage	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 100$	nA
<b>ON CHARACTERISTICS<sup>b</sup></b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	1.0	1.8	3.0	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=10A$		23	30	m ohm
		$V_{GS}=4.5V, I_D=6A$		27	38	m ohm
On-State Drain Current	$I_{D(ON)}$	$V_{DS}=5V, V_{GS}=10V$	30			A
Forward Transconductance	$g_{FS}$	$V_{DS}=10V, I_D=10A$		20		S
<b>DYNAMIC CHARACTERISTICS<sup>c</sup></b>						
Input Capacitance	$C_{ISS}$	$V_{DS}=30V, V_{GS}=0V$ $f=1.0MHz$		1230		pF
Output Capacitance	$C_{OSS}$			125		pF
Reverse Transfer Capacitance	$C_{RSS}$			80		pF
Gate resistance	$R_g$	$V_{GS}=0V, V_{DS}=0V, f=1.0MHz$		3		ohm
<b>SWITCHING CHARACTERISTICS<sup>c</sup></b>						
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=30V$ $I_D=10A$ $V_{GS}=10V$ $R_{GEN}=3.3\text{ ohm}$		21		ns
Rise Time	$t_r$			23		ns
Turn-Off Delay Time	$t_{D(OFF)}$			50		ns
Fall Time	$t_f$			12		ns
Total Gate Charge	$Q_g$	$V_{DS}=30V, I_D=10A, V_{GS}=10V$		24.5		nC
		$V_{DS}=30V, I_D=10A, V_{GS}=4.5V$		12		nC
Gate-Source Charge	$Q_{gs}$	$V_{DS}=30V, I_D=10A$		2.8		nC
Gate-Drain Charge	$Q_{gd}$	$V_{GS}=10V$		6		nC

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## ELECTRICAL CHARACTERISTICS ( $T_c=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>DRAIN-SOURCE DIODE CHARACTERISTICS <sup>a</sup></b>						
Diode Forward Voltage	$V_{SD}$	$V_{GS} = 0V, I_s = 15A$		1	1.3	V

### Notes

- a. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
- b. Guaranteed by design, not subject to production testing.

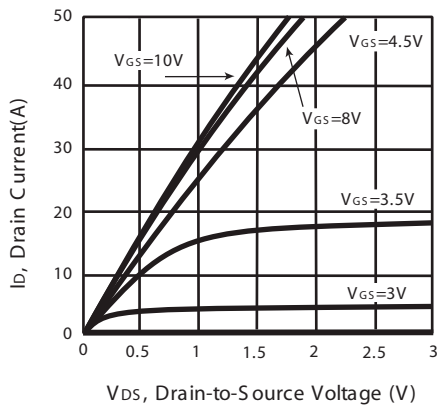


Figure 1. Output Characteristics

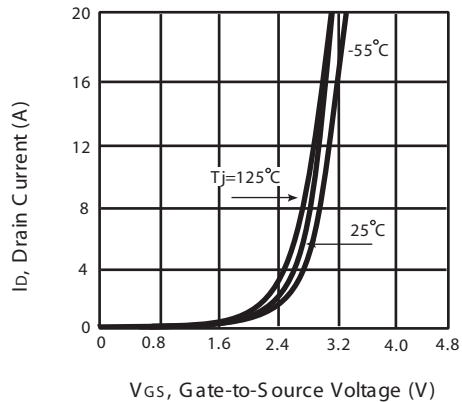


Figure 2. Transfer Characteristics

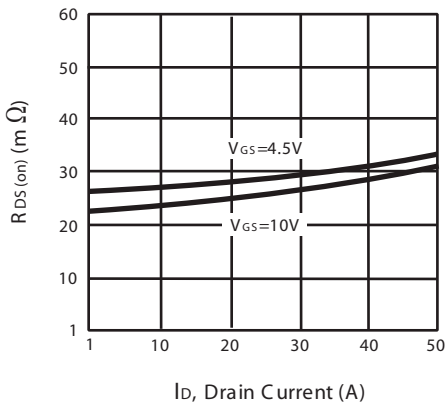


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

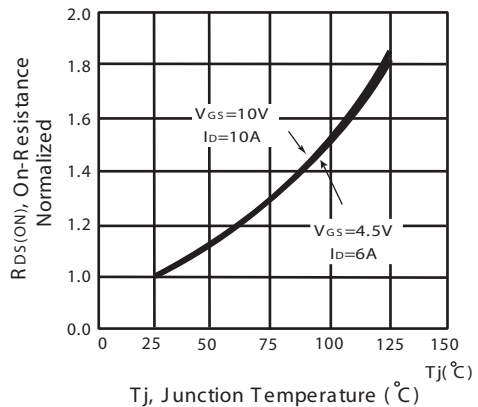


Figure 4. On-Resistance Variation with Drain Current and Temperature

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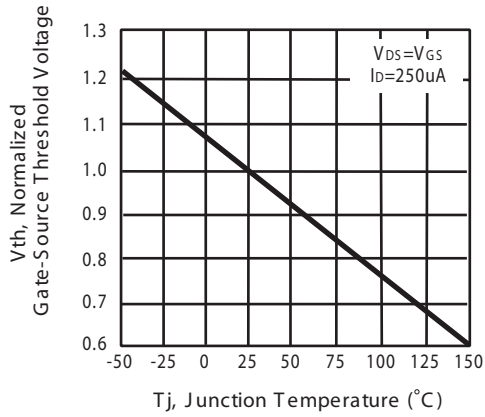


Figure 5. Gate Threshold Variation with Temperature

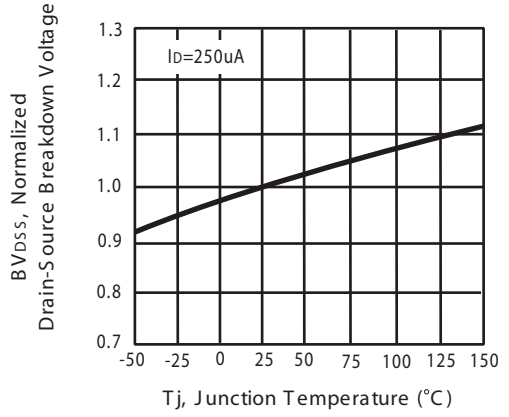


Figure 6. Breakdown Voltage Variation with Temperature

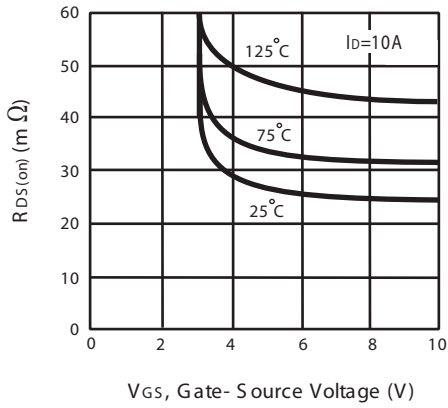


Figure 7. On-Resistance vs. Gate-Source Voltage

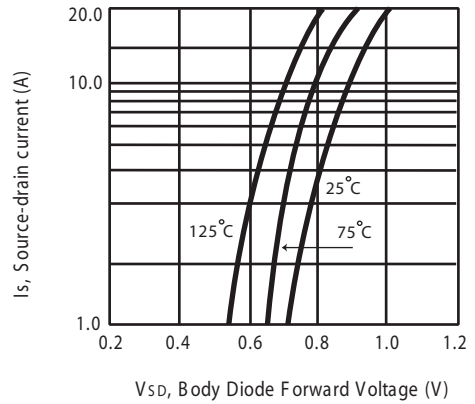
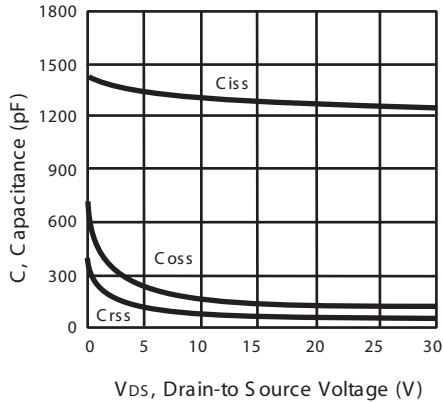


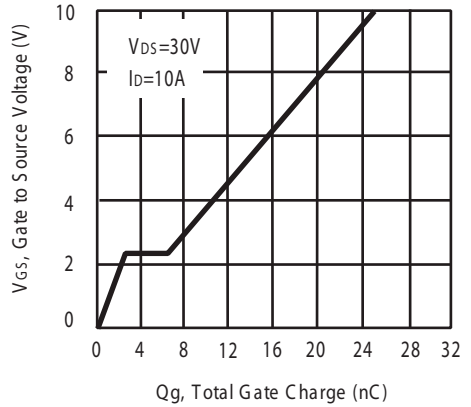
Figure 8. Body Diode Forward Voltage Variation with Source Current

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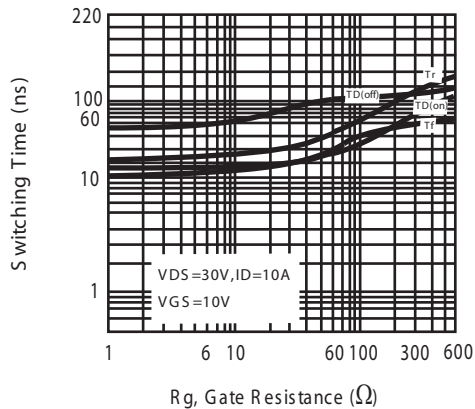
$V_{DS}$ , Drain-to Source Voltage (V)

Figure 9. Capacitance



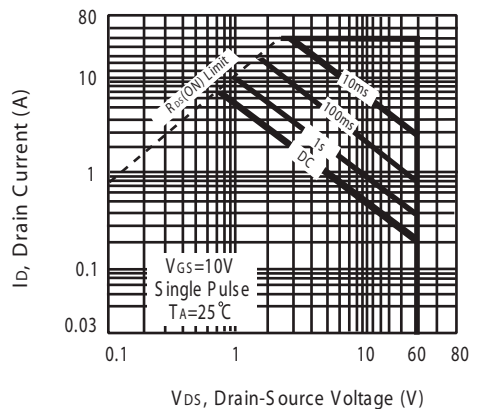
$Q_g$ , Total Gate Charge (nC)

Figure 10. Gate Charge



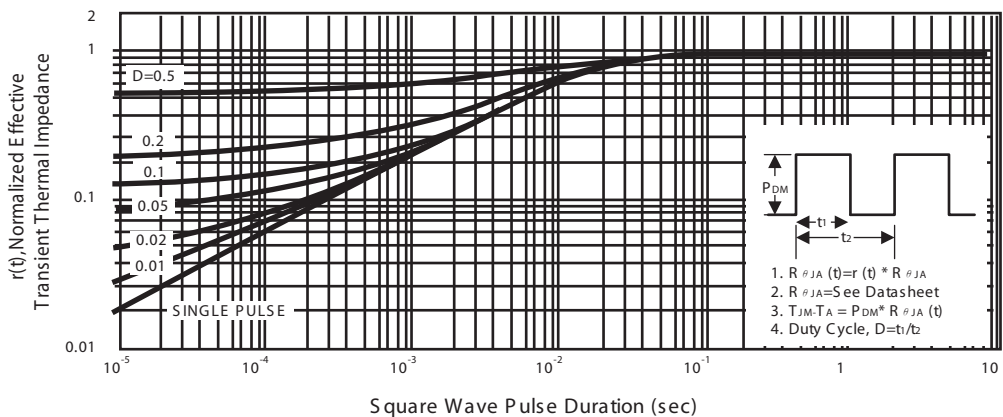
$R_g$ , Gate Resistance ( $\Omega$ )

Figure 11. switching characteristics



$V_{DS}$ , Drain-Source Voltage (V)

Figure 12. Maximum Safe Operating Area



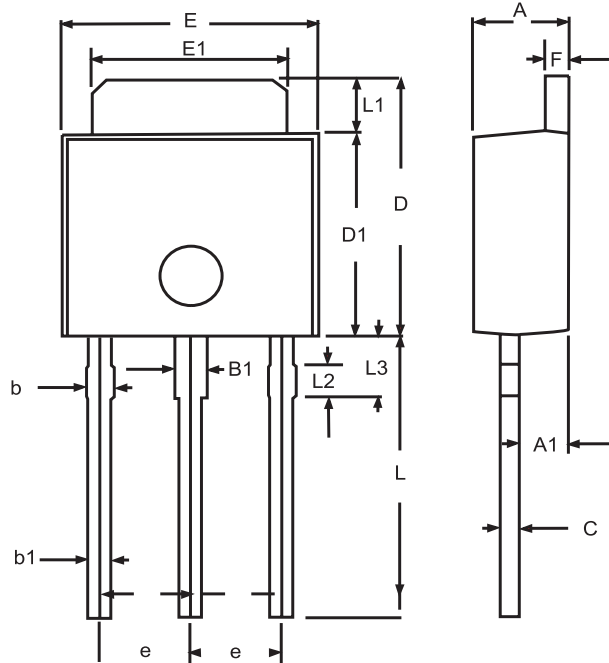
Square Wave Pulse Duration (sec)

Figure 13. Normalized Thermal Transient Impedance Curve

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## PACKAGE OUTLINE DIMENSIONS

TO-251

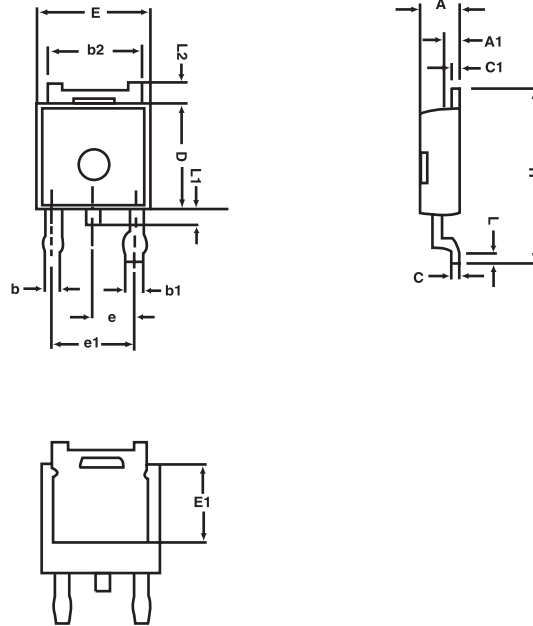


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.40	0.087	0.095
A1	1.100	1.300	0.043	0.051
B1	0.650	1.050	0.026	0.041
b	0.500	0.900	0.020	0.035
b1	0.400	0.800	0.016	0.32
C	0.400	0.600	0.016	0.024
D	6.700	7.300	0.264	0.287
D1	5.400	5.650	0.213	0.222
E	6.40	6.650	0.252	0.262
e	2.100	2.500	0.083	0.098
F	0.400	0.600	0.016	0.024
L	7.000	8.000	0.276	0.315
L1	1.300	1.700	0.051	0.067
L2	0.700	0.900	0.028	0.035
L3	1.400	1.800	0.055	0.071

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## PACKAGE OUTLINE DIMENSIONS

### TO-252

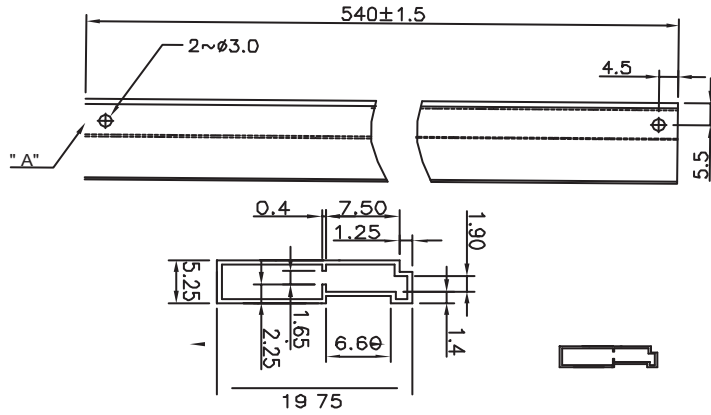


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.25	2.35	0.089	0.093
A1	0.95	1.05	0.037	0.041
b	0.77	0.85	0.030	0.033
b1	0.84	0.94	0.033	0.037
b2	5.30	5.45	0.209	0.215
C	0.49	0.53	0.019	0.021
D	6.00	6.20	0.236	0.244
E	6.40	6.60	0.252	0.260
E1	3.18	3.67	0.125	0.145
e	2.29	BSC	0.090	BSC
H	9.70	10.10	0.382	0.398
L	1.425	1.625	0.056	0.064
L1	0.650	0.850	0.026	0.033
L2	0.600	REF.	0.024	REF.

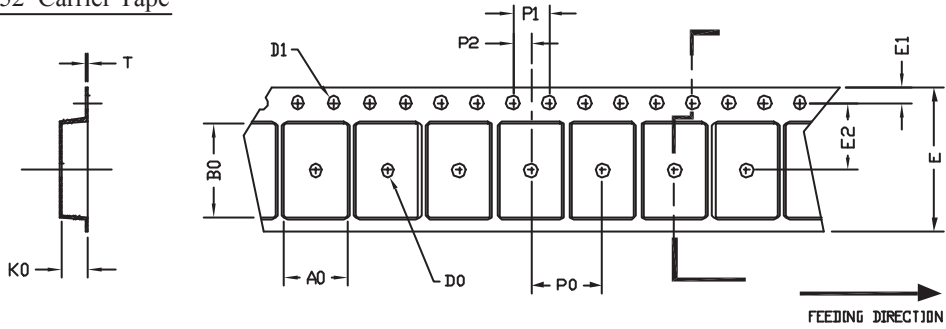
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## TO251 Tube/TO-252 Tape and Reel Data

### TO-251 Tube



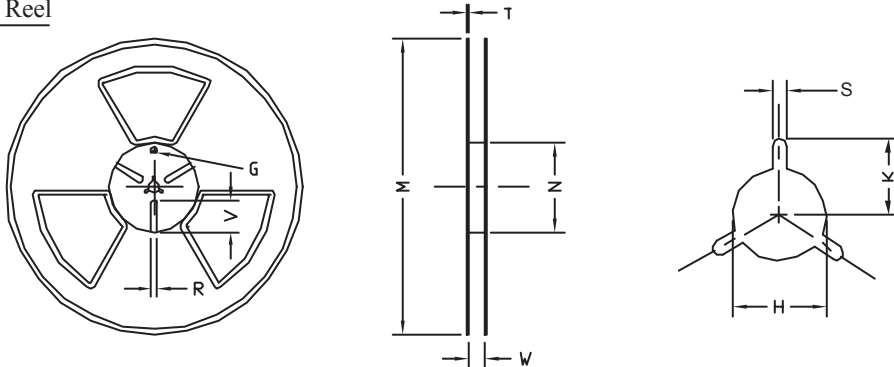
### TO-252 Carrier Tape



UNIT:mm

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
TO-252 (16 mm)	6.80 $\pm 0.1$	10.3 $\pm 0.1$	2.50 $\pm 0.1$	$\phi 2$	$\phi 1.5$ $+ 0.1$ $- 0$	16.0 $0.3 \pm$	1.75 $0.1 \pm$	7.5 $\pm 0.15$	8.0 $\pm 0.1$	4.0 $\pm 0.1$	2.0 $\pm 0.15$	0.3 $\pm 0.05$

### TO-252 Reel



UNIT:mm

TAPE SIZE	REEL SIZE	M	N	W	T	H	K	S	G	R	V
16 mm	$\phi 330$	$\phi 330$ $\pm 0.5$	$\phi 97$ $\pm 1.0$	17.0 $+ 1.5$ $- 0$	2.2	$\phi 13.0$ $+ 0.5$ $- 0.2$	10.6	2.0 $\pm 0.5$	---	---	---