



# STU/D2040PL

## P-Channel Enhancement Mode MOSFET

### PRODUCT SUMMARY

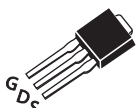
V <sub>DS</sub>	I <sub>D</sub>	R <sub>DS(ON)</sub> (m $\Omega$ ) Max
-40V	-20A	45 @ V <sub>GS</sub> = -10V
		60 @ V <sub>GS</sub> = -4.5V

### FEATURES

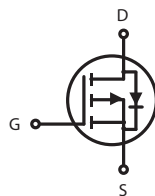
- Super high dense cell design for low R<sub>DS(ON)</sub>.
- Rugged and reliable.
- TO-252 and TO-251 Package.



STU SERIES  
TO-252AA(D-PAK)



STD SERIES  
TO-251(I-PAK)



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

Parameter		Symbol	Limit	Unit
Drain-Source Voltage		V <sub>DS</sub>	-40	V
Gate-Source Voltage		V <sub>GS</sub>	±20	V
Drain Current-Continuous <sup>a</sup> @ T <sub>a</sub>	25°C	I <sub>D</sub>	-20	A
	70°C		-16.7	A
-Pulsed <sup>b</sup>		I <sub>DM</sub>	-84	A
Drain-Source Diode Forward Current <sup>a</sup>		I <sub>S</sub>	-20	A
Maximum Power Dissipation <sup>a</sup>	T <sub>a</sub> = 25°C	P <sub>D</sub>	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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P-Channel ELECTRICAL CHARACTERISTICS (TA = 25 °C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ <sup>c</sup>	Max	Unit
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = -250uA	-40			V
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = -32V, V <sub>GS</sub> = 0V			1	uA
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0V			±100	nA
ON CHARACTERISTICS <sup>b</sup>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250uA	-0.8	-1.5	-2.0	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = -10V, I <sub>D</sub> = -16A		35	45	m ohm
		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -10A		46	60	m ohm
On-State Drain Current	I <sub>D(ON)</sub>	V <sub>DS</sub> = -5V, V <sub>GS</sub> = -10V	50			A
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -10V, I <sub>D</sub> = -15A		15		S
DYNAMIC CHARACTERISTICS <sup>c</sup>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = -10V, V <sub>GS</sub> = 0V f = 1.0MHz		1115	1250	pF
Output Capacitance	C <sub>OSS</sub>			200	225	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			125	140	pF
Gate resistance	R <sub>g</sub>	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V, f = 1.0MHz		3		ohm
SWITCHING CHARACTERISTICS <sup>c</sup>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = -24V I <sub>D</sub> = -16 A V <sub>GS</sub> = -10V R <sub>GEN</sub> = 4.7 ohm		11.5	13	ns
Rise Time	t <sub>r</sub>			7.3	8.5	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			53.1	62	ns
Fall Time	t <sub>f</sub>			31.8	37	ns
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> = -24V, I <sub>D</sub> = -16A, V <sub>GS</sub> = -10V		19.5	22	nC
		V <sub>DS</sub> = -24V, I <sub>D</sub> = -16A, V <sub>GS</sub> = -4.5V		9.4	11	nC
Gate-Source Charge	Q <sub>gs</sub>	V <sub>DS</sub> = -24V, I <sub>D</sub> = -16A V <sub>GS</sub> = -10V		4.1	4.8	nC
Gate-Drain Charge	Q <sub>gd</sub>			2.8	3.2	nC

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## ELECTRICAL CHARACTERISTICS (T<sub>c</sub>=25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
DRAIN-SOURCE DIODE CHARACTERISTICS <sup>a</sup>						
Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0V, I <sub>s</sub> = -20A		-1.02	-1.3	V

### Notes

- a. Pulse Test: Pulse Width ≤ 300us, Duty Cycle ≤ 2%.
- b. Guaranteed by design, not subject to production testing.

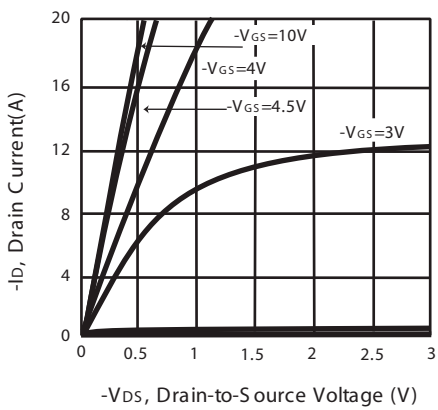


Figure 1. Output Characteristics

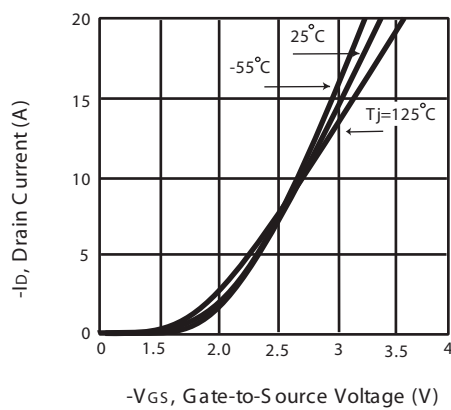


Figure 2. Transfer Characteristics

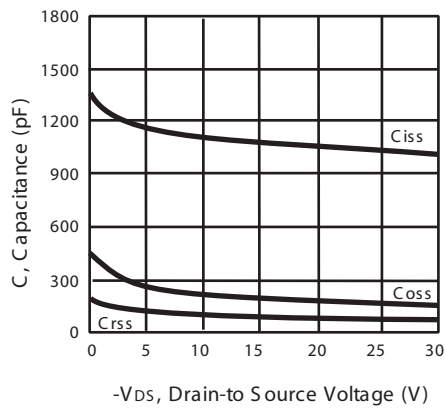


Figure 3. Capacitance

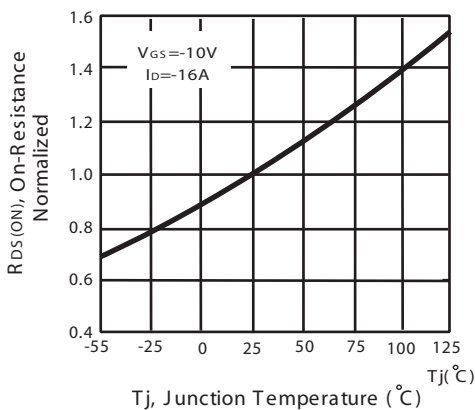


Figure 4. On-Resistance Variation with Drain Current and Temperature

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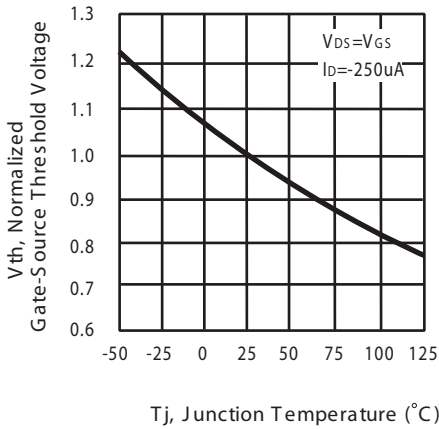


Figure 5. Gate Threshold Variation with Temperature

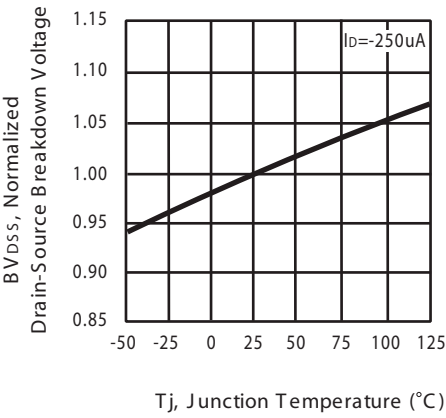


Figure 6. Breakdown Voltage Variation with Temperature

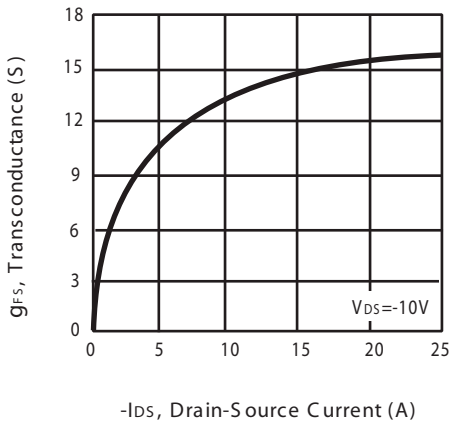


Figure 7. Transconductance Variation with Drain Current

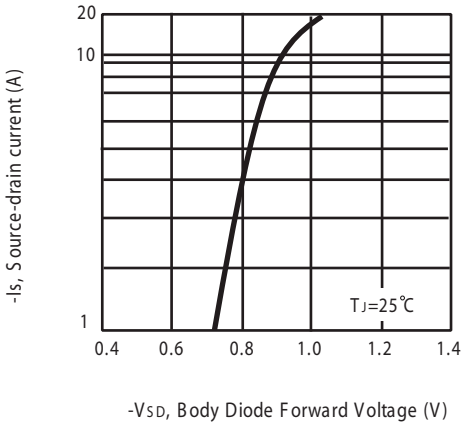


Figure 8. Body Diode Forward Voltage Variation with Source Current

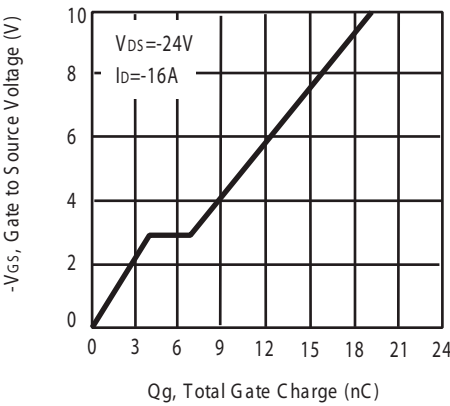


Figure 9. Gate Charge

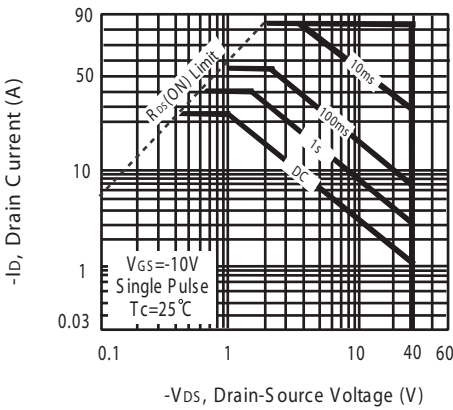


Figure 10. Maximum Safe Operating Area

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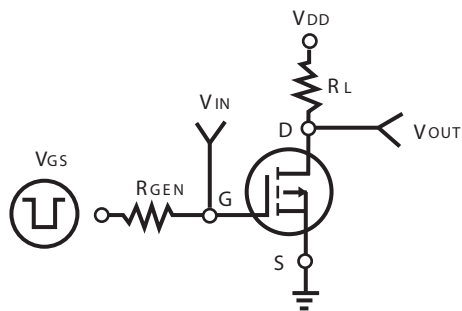


Figure 11. Switching Test Circuit

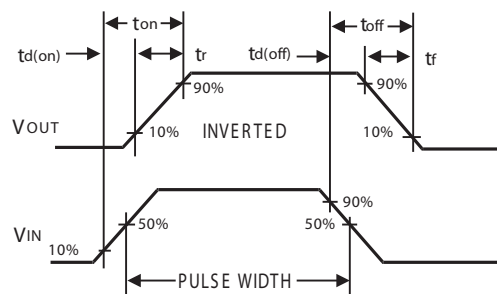
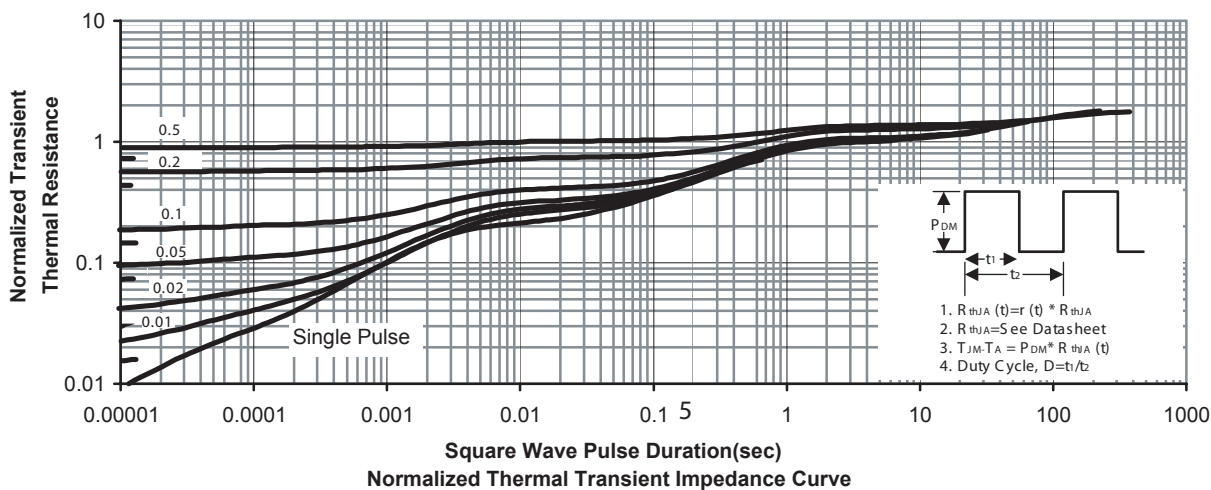


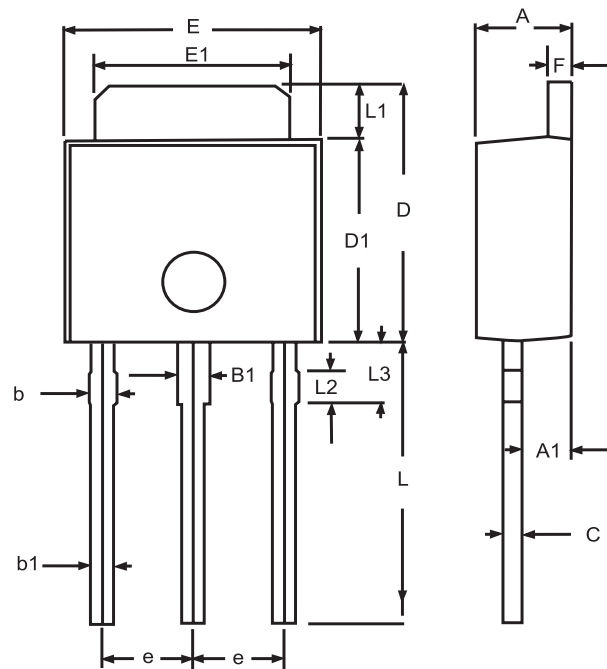
Figure 12. Switching Waveforms



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## PACKAGE OUTLINE DIMENSIONS

### TO-251

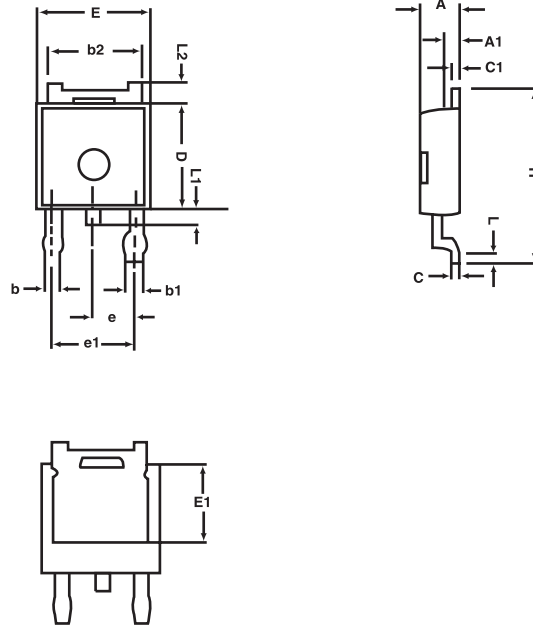


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.20	2.40	0.087	0.095
A1	1.100	1.300	0.043	0.051
B1	0.650	1.050	0.026	0.041
b	0.500	0.900	0.020	0.035
b1	0.400	0.800	0.016	0.32
C	0.400	0.600	0.016	0.024
D	6.700	7.300	0.264	0.287
D1	5.400	5.650	0.213	0.222
E	6.40	6.650	0.252	0.262
e	2.100	2.500	0.083	0.098
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

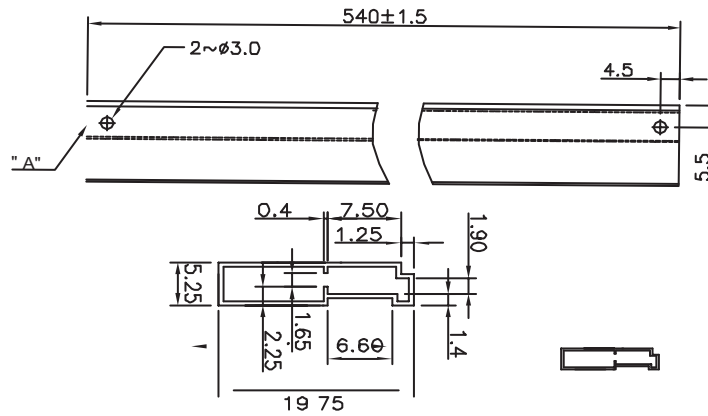


SYMBOLS	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.25	2.35	0.089	0.093
A1	0.95	1.05	0.037	0.041
b	0.77	0.85	0.030	0.033
b1	0.84	0.94	0.033	0.037
b2	5.30	5.45	0.209	0.215
C	0.49	0.53	0.019	0.021
D	6.00	6.20	0.236	0.244
E	6.40	6.60	0.252	0.260
E1	3.18	3.67	0.125	0.145
e	2.29	BSC	0.090	BSC
H	9.70	10.10	0.382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

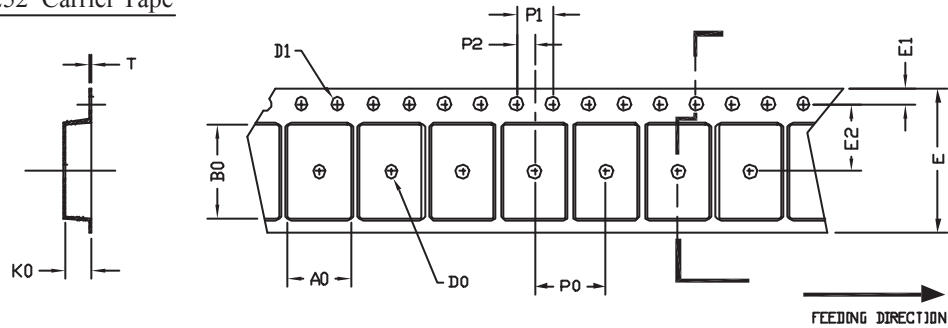
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## TO251 Tube/TO-252 Tape and Reel Data

### TO-251 Tube



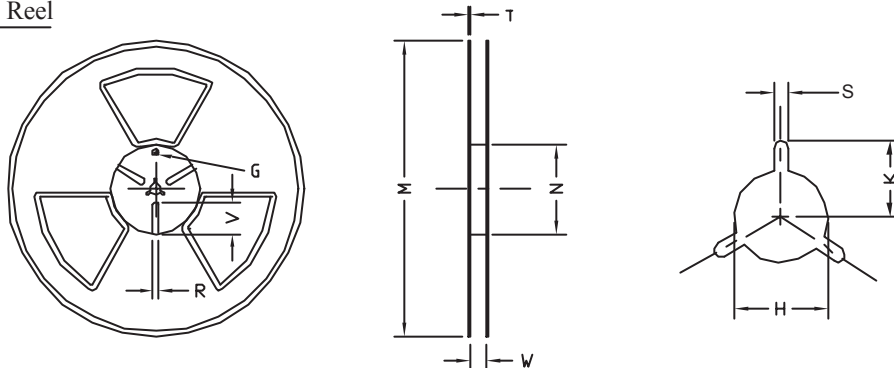
### TO-252 Carrier Tape



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 $\pm 0.5$	---	---	---