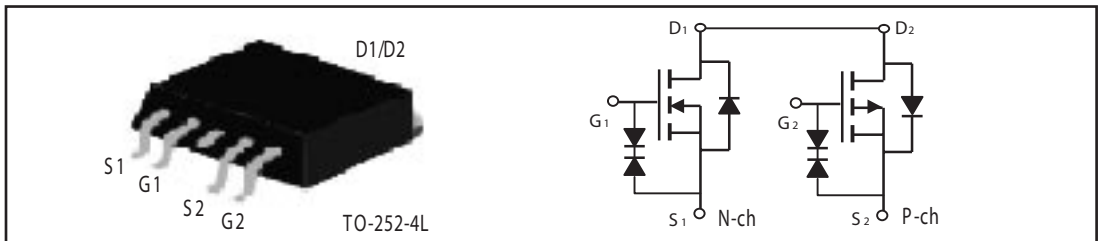




## Dual Enhancement Mode Field Effect Transistor ( N and P Channel)

PRODUCT SUMMARY (N-Channel)		
V <sub>DSS</sub>	I <sub>D</sub>	R <sub>DS(ON)</sub> ( m Ω ) Max
40V	18A	24 @ V <sub>GS</sub> = 10V
		30 @ V <sub>GS</sub> = 4.5V

PRODUCT SUMMARY (P-Channel)		
V <sub>DSS</sub>	I <sub>D</sub>	R <sub>DS(ON)</sub> ( m Ω ) Max
-40V	-14A	35 @ V <sub>GS</sub> = -10V
		50 @ V <sub>GS</sub> = -4.5V



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

Parameter	Symbol	N-Channel	P-Channel	Unit
Drain-Source Voltage	V <sub>DS</sub>	40	-40	V
Gate-Source Voltage	V <sub>GS</sub>	±20	±20	V
Drain Current-Continuous @ T <sub>c</sub>	I <sub>D</sub>	18	-14	A
		15	-11	A
-Pulsed <sup>a</sup>	I <sub>DM</sub>	50	-50	A
Drain-Source Diode Forward Current	I <sub>S</sub>	8	-6	A
Maximum Power Dissipation	P <sub>D</sub>	11		W
		7.7		
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 <sub>θJC</sub>	13.6	°C/W
Thermal Resistance, Junction-to-Ambient	R <sub>θJA</sub>	120	°C/W

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N-Channel ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ <sup>c</sup>	Max	Unit
<b>OFF CHARACTERISTICS</b>						
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			±10	uA
<b>ON CHARACTERISTICS<sup>a</sup></b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250uA	1	1.8	3	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 8A		18	24	m ohm
		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 6A		23	30	m ohm
On-State Drain Current	I <sub>D(ON)</sub>	V <sub>DS</sub> = 5V, V <sub>GS</sub> = 4.5V	20			A
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 8A		17		S
<b>DYNAMIC CHARACTERISTICS<sup>b</sup></b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 20V, V <sub>GS</sub> = 0V f = 1.0MHz		700		pF
Output Capacitance	C <sub>OSS</sub>			120		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			75		pF
<b>SWITCHING CHARACTERISTICS<sup>b</sup></b>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 20V I <sub>D</sub> = 3 A V <sub>GS</sub> = 10V R <sub>GEN</sub> = 3 ohm		11		ns
Rise Time	t <sub>r</sub>			12		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			45		ns
Fall Time	t <sub>f</sub>			11		ns
Total Gate Charge	Q <sub>g</sub>		V <sub>DS</sub> = 20V, I <sub>D</sub> = 8A, V <sub>GS</sub> = 10V		14	
		V <sub>DS</sub> = 20V, I <sub>D</sub> = 8A, V <sub>GS</sub> = 4.5V		7		nC
Gate-Source Charge	Q <sub>gs</sub>	V <sub>DS</sub> = 20V, I <sub>D</sub> = 8 A V <sub>GS</sub> = 10V		1.6		nC
Gate-Drain Charge	Q <sub>gd</sub>			3.4		nC

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## P-Channel ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25 °C unless otherwise noted)

Parameter	Symbol	Condition	Min	Typ <sup>c</sup>	Max	Unit
<b>OFF CHARACTERISTICS</b>						
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			±10	uA
<b>ON CHARACTERISTICS<sup>a</sup></b>						
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250uA	-1	-1.8	-3	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = -10V, I <sub>D</sub> = -6A		28	35	m ohm
		V <sub>GS</sub> = -4.5V, I <sub>D</sub> = -4A		42	50	m ohm
On-State Drain Current	I <sub>D(ON)</sub>	V <sub>DS</sub> = -5V, V <sub>GS</sub> = -10V	-20			A
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> = -10V, I <sub>D</sub> = -6A		11		S
<b>DYNAMIC CHARACTERISTICS<sup>b</sup></b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = -20V, V <sub>GS</sub> = 0V f = 1.0MHz		1000		pF
Output Capacitance	C <sub>OSS</sub>			175		pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			95		pF
<b>SWITCHING CHARACTERISTICS<sup>b</sup></b>						
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = -20V I <sub>D</sub> = -3A V <sub>GS</sub> = -10V R <sub>GEN</sub> = 3 ohm		11		ns
Rise Time	t <sub>r</sub>			15		ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			72		ns
Fall Time	t <sub>f</sub>			30		ns
Total Gate Charge	Q <sub>g</sub>		V <sub>DS</sub> = -20V, I <sub>D</sub> = -6A, V <sub>GS</sub> = -10V		17.5	
		V <sub>DS</sub> = -20V, I <sub>D</sub> = -6A, V <sub>GS</sub> = -4.5V		8.5		nC
Gate-Source Charge	Q <sub>gs</sub>	V <sub>DS</sub> = -20V, I <sub>D</sub> = -6 A		2.3		nC
Gate-Drain Charge	Q <sub>gd</sub>	V <sub>GS</sub> = -10V		4.5		nC

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

Parameter	Symbol	Condition	Min	Typ <sup>c</sup>	Max	Unit
<b>DRAIN-SOURCE DIODE CHARACTERISTICS<sup>b</sup></b>						
Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0V, I <sub>S</sub> = 8A V <sub>GS</sub> = 0V, I <sub>S</sub> = -6A	N-Ch P-Ch	0.94 -0.87	1.3 -1.3	V

Notes

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

N-Channel

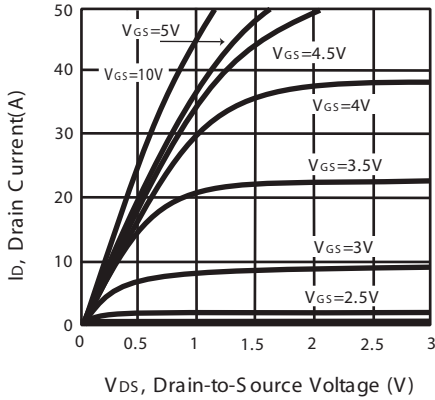


Figure 1. Output Characteristics

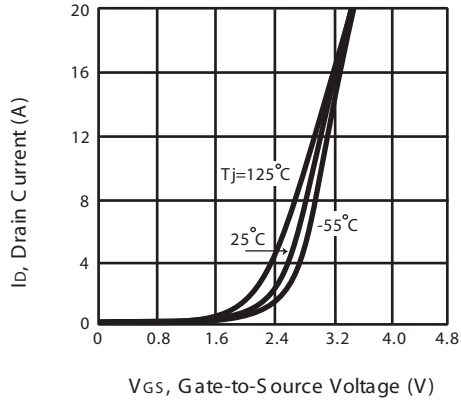


Figure 2. Transfer Characteristics

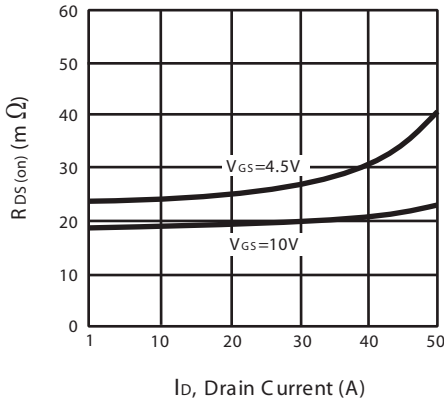


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

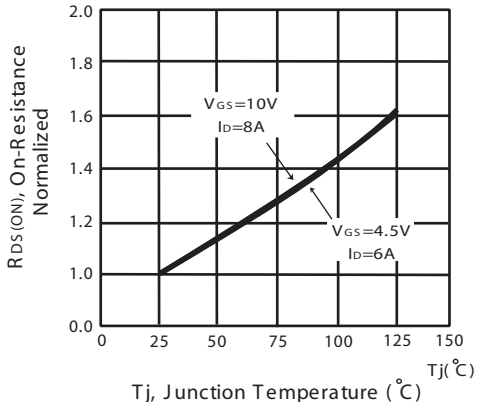


Figure 4. On-Resistance Variation with Drain Current and Temperature

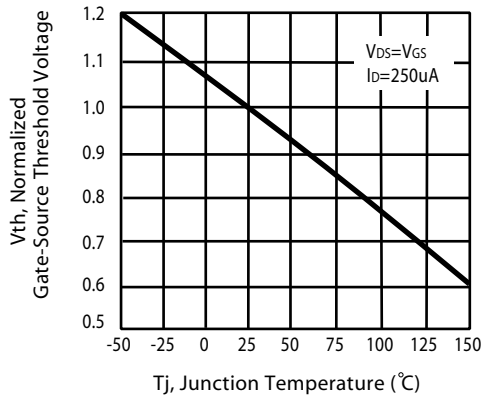


Figure 5. Gate Threshold Variation with Temperature

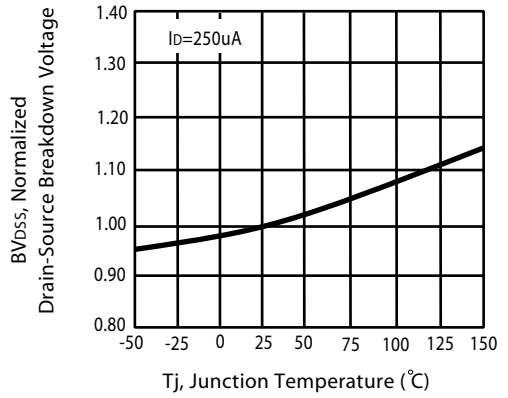


Figure 6. Breakdown Voltage Variation with Temperature

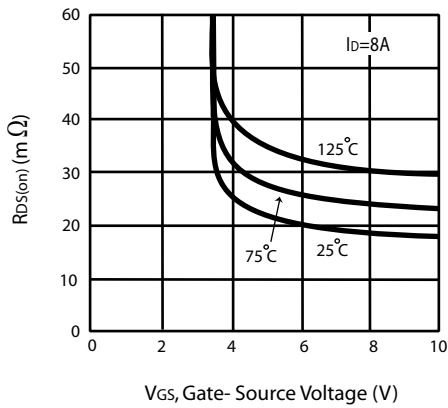


Figure 7. On-Resistance vs. Gate-Source Voltage

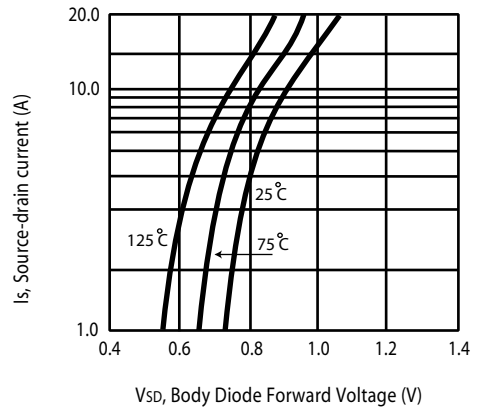


Figure 8. Body Diode Forward Voltage Variation with Source Current

# STU409DH

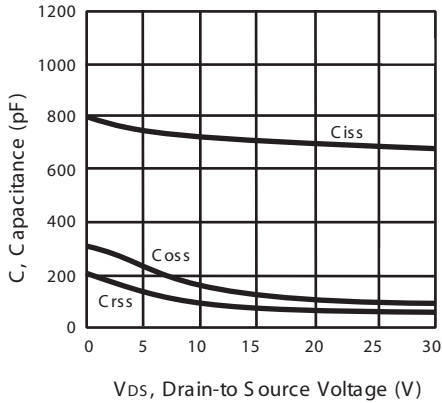


Figure 9. Capacitance

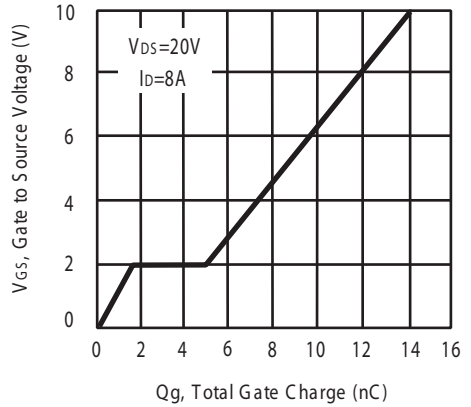


Figure 10. Gate Charge

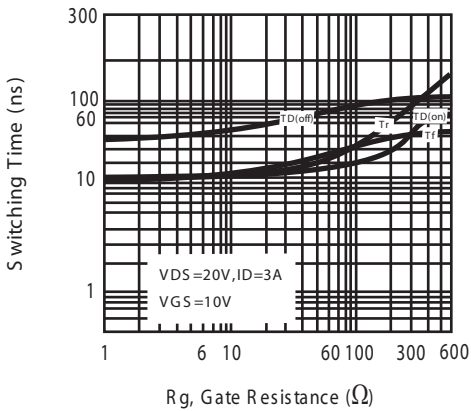


Figure 11. switching characteristics

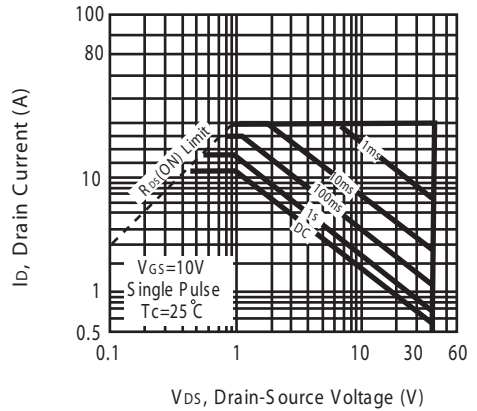
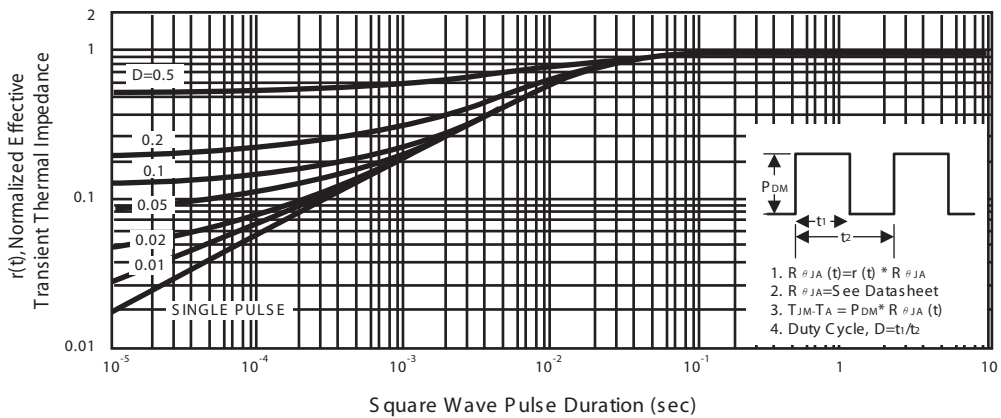


Figure 12. Maximum Safe Operating Area



1.  $R_{\theta JA}(t) = r(t) * R_{\theta JA}$
2.  $R_{\theta JA}$  = See Datasheet
3.  $T_{JM-TA} = P_{DM} * R_{\theta JA}(t)$
4. Duty Cycle,  $D = t_1/t_2$

www.DataSheet4U.com Figure 13. Normalized Thermal Transient Impedance Curve

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## P-Channel

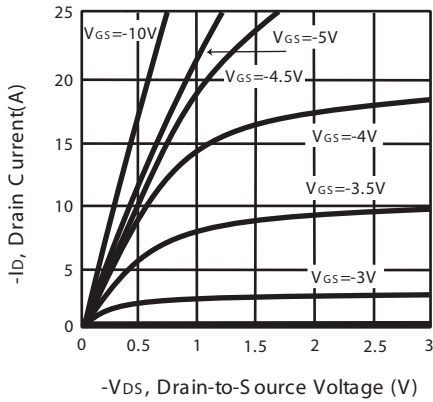


Figure 1. Output Characteristics

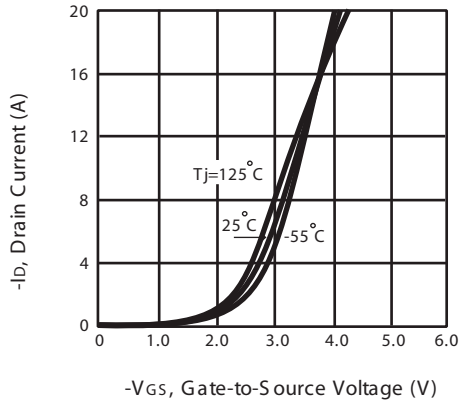


Figure 2. Transfer Characteristics

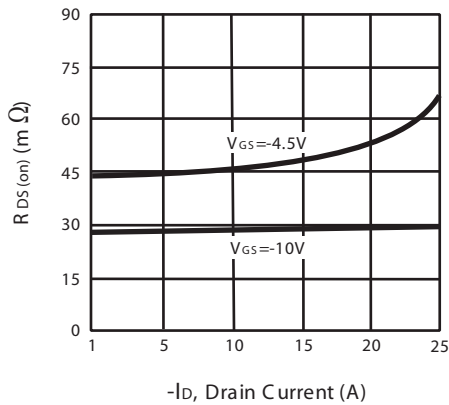


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

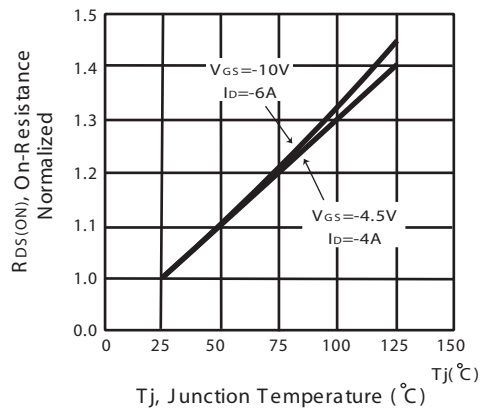


Figure 4. On-Resistance Variation with Drain Current and Temperature

# STU409DH

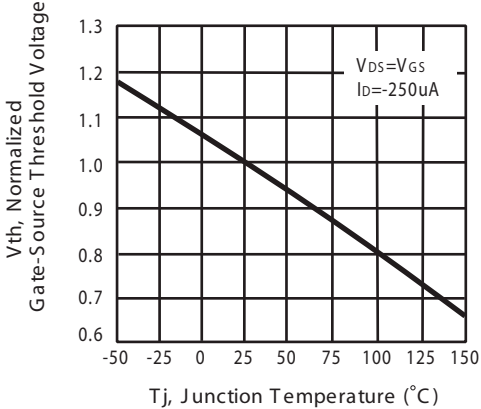


Figure 5. Gate Threshold Variation with Temperature

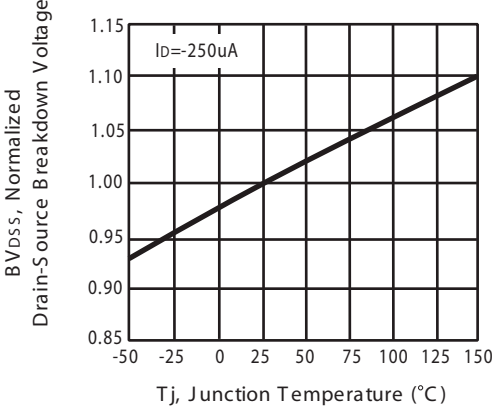


Figure 6. Breakdown Voltage Variation with Temperature

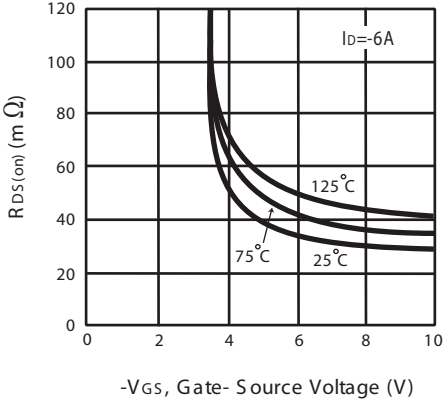


Figure 7. On-Resistance vs. Gate-Source Voltage

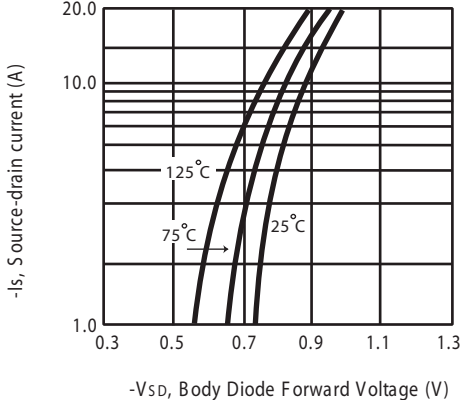


Figure 8. Body Diode Forward Voltage Variation with Source Current



# STU409DH

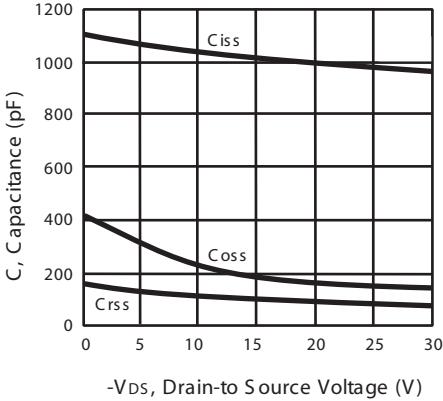


Figure 9. Capacitance

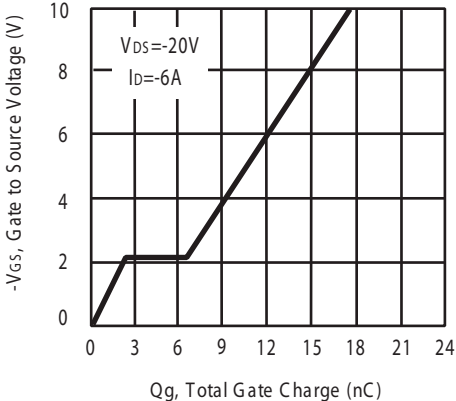


Figure 10. Gate Charge

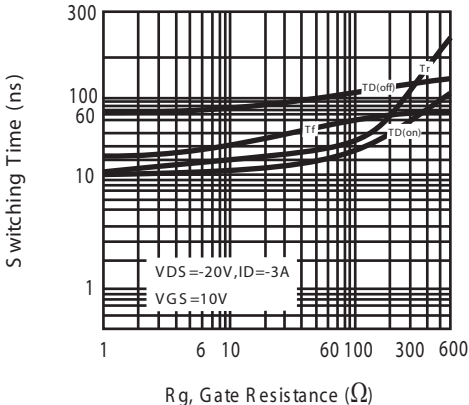


Figure 11. switching characteristics

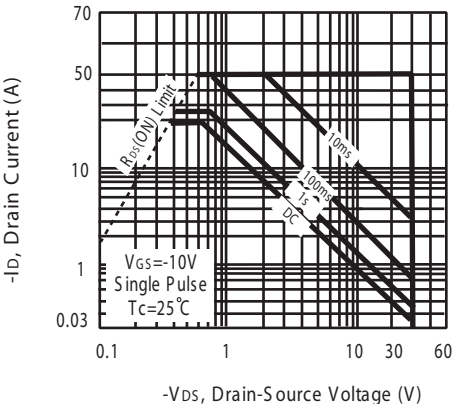


Figure 12. Maximum Safe Operating Area

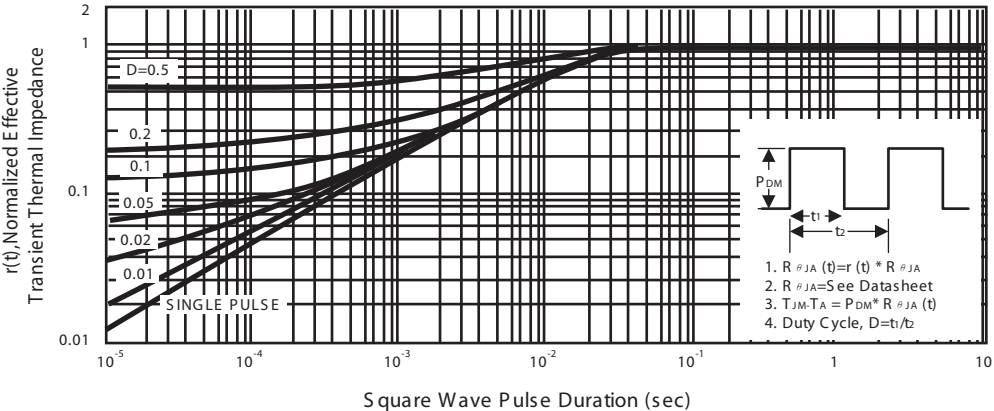
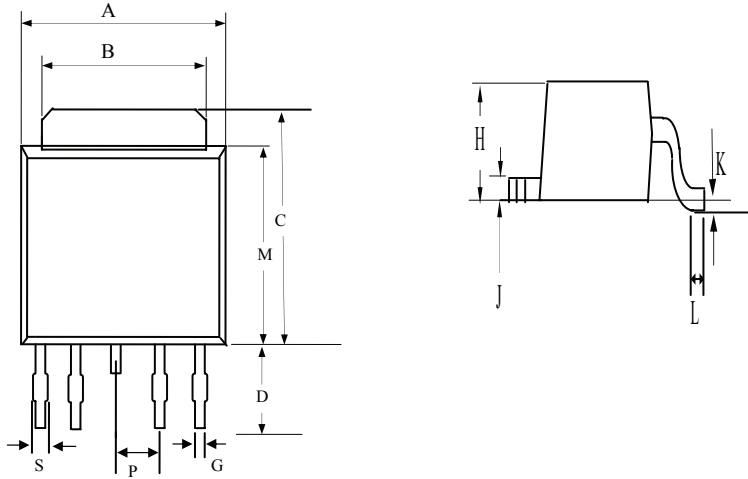


Figure 13. Normalized Thermal Transient Impedance Curve

# STU409DH

## PACKAGE OUTLINE DIMENSIONS

TO-252-4L



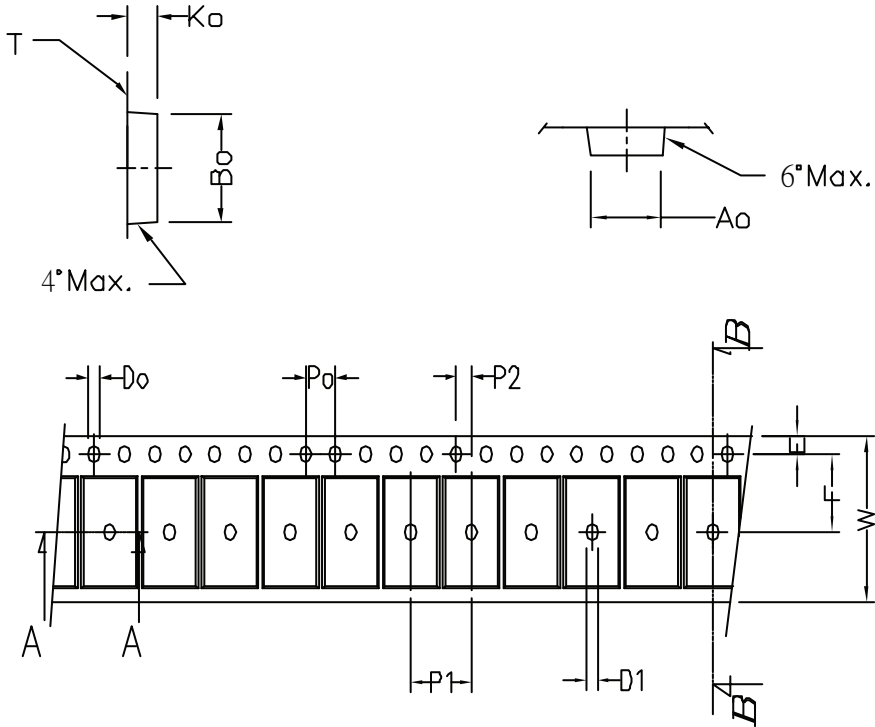
REF .	Millimeters	
	MIN	MAX
A	6.40	6.80
B	5.2	5.50
C	6.80	10.20
D	2.20	3.00
P	1.27 REF.	
S	0.50	0.80
G	0.40	0.60
H	2.20	2.40
J	0.45	0.60
K	0	0.15
L	0.90	1.50
M	5.40	5.80

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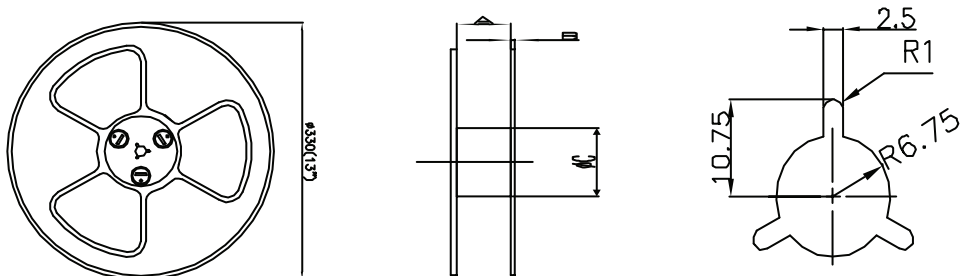
## TO-252-4L Tape and Reel Data

### TO-252-4L Carrier Tape



symbol	$A_0$	$B_0$	$K_0$	$P_0$	$P_1$	$P_2$	$T$
Spec	$6.96 \pm 0.1$	$10.49 \pm 0.1$	$2.79 \pm 0.1$	$4.0 \pm 0.1$	$8.0 \pm 0.10$	$2.0 \pm 0.05$	$0.33 \pm 0.013$
symbol	$E$	$F$	$D_0$	$D_1$	$W$	$10P_0$	
Spec	$1.75 \pm 0.1$	$7.5 \pm 0.05$	$1.55 \pm 0.05$	$1.5 \pm 0.25$	$16.0^{+0.3}_{-0.1}$	$40.0 \pm 0.2$	

### TO-252-4L Reel



UNIT:mm

Width of carrier tape	8	12	16	24	32	44	56
$A \pm 0.1$	9.4	13.4	17.4	25.4	33.4	45.4	57.4
$B$	2.3	2.3	2.3	2.3	2.3	2.3	2.3
$\phi C$	100	100	100	100	100	100	100