

40V Complementary Power MOSFET

Feature

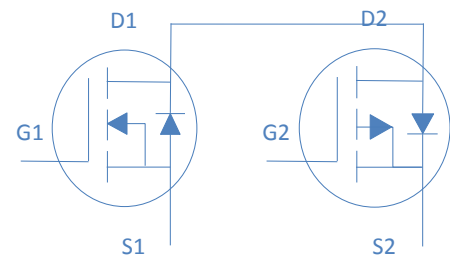
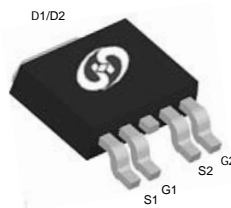
- ◇ High Speed Power Switching, Logic Level
- ◇ Enhanced Avalanche Ruggedness
- ◇ Lead Free, Halogen Free

	N-CH	P-CH	
V_{DS}	40	-40	V
$R_{DS(on),max}$	35	44	mΩ
I_D (Silicon Limited)	12	-9	A

Application

- ◇ Hard Switching and High Speed Circuit
- ◇ BLDC motor

TO-252-4L



Part Number	Package	Marking
HTD350C04	TO-252	TD350C04

Absolute Maximum Ratings at $T_j=25^\circ\text{C}$ (unless otherwise specified)

Parameter	Symbol	Conditions	N-CH	P-CH	Unit
Continuous Drain Current (Silicon Limited)	I_D	$T_C=25^\circ\text{C}$	12	-9	A
		$T_C=100^\circ\text{C}$	8	-6	
Drain to Source Voltage	V_{DS}	-	40	-40	V
Gate to Source Voltage	V_{GS}	-	±20		V
Pulsed Drain Current	I_{DM}	-	48	-36	A
Power Dissipation	P_D	$T_C=25^\circ\text{C}$	21		W
Operating and Storage Temperature	T_J, T_{stg}	-	-55 to 150		$^\circ\text{C}$

Absolute Maximum Ratings

Parameter	Symbol	Max	Unit
Thermal Resistance Junction-Ambient	$R_{\theta JA}$	42	$^\circ\text{C}/\text{W}$
Thermal Resistance Junction-Case	$R_{\theta JC}$	6	$^\circ\text{C}/\text{W}$

N-Channel Electrical Characteristics at $T_j=25^\circ\text{C}$ (unless otherwise specified)
Static Characteristics

Parameter	Symbol	Conditions	Value			Unit
			min	typ	max	
Drain to Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=250\mu A$	40	-	-	V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	1.8	2.3	3.2	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS}=0V, V_{DS}=32V, T_j=25^\circ\text{C}$	-	-	1	μA
		$V_{GS}=0V, V_{DS}=30V, T_j=125^\circ\text{C}$	-	-	25	
Gate to Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
Drain to Source on Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=10A$	-	30	35	$m\Omega$
		$V_{GS}=7V, I_D=8A$	-	40	50	
Transconductance	g_{fs}	$V_{DS}=5V, I_D=10A$	-	19	-	S

Dynamic Characteristics

Input Capacitance	C_{iss}	$V_{GS}=0V, V_{DS}=20V, f=1\text{MHz}$	-	515	-	pF
Output Capacitance	C_{oss}		-	77	-	
Reverse Transfer Capacitance	C_{rss}		-	53	-	
Total Gate Charge	$Q_g(10V)$	$V_{DD}=20V, I_D=15A, V_{GS}=10V$	-	13.1	-	nC
Gate to Source Charge	Q_{gs}		-	1.9	-	
Gate to Drain (Miller) Charge	Q_{gd}		-	4.1	-	
Turn on Delay Time	$t_{d(on)}$	$V_{DD}=10V, I_D=1A, V_{GS}=10V, R_G=6\Omega,$	-	2.5	-	ns
Rise time	t_r		-	7.5	-	
Turn off Delay Time	$t_{d(off)}$		-	12	-	
Fall Time	t_f		-	4	-	

Reverse Diode Characteristics

Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_F=12A$	-		1.3	V
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Fig 1. Typical Output Characteristics

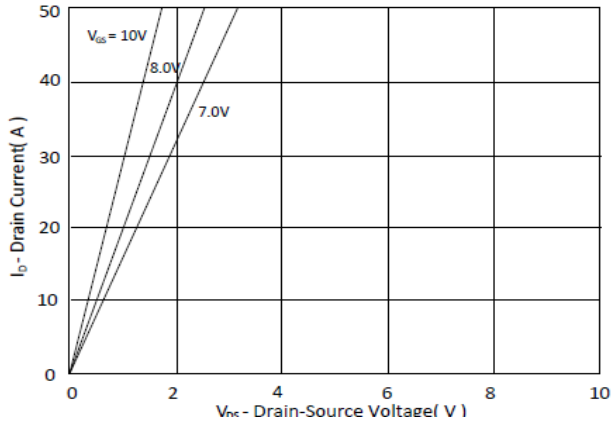


Figure 2. On-Resistance vs. Gate-Source Voltage

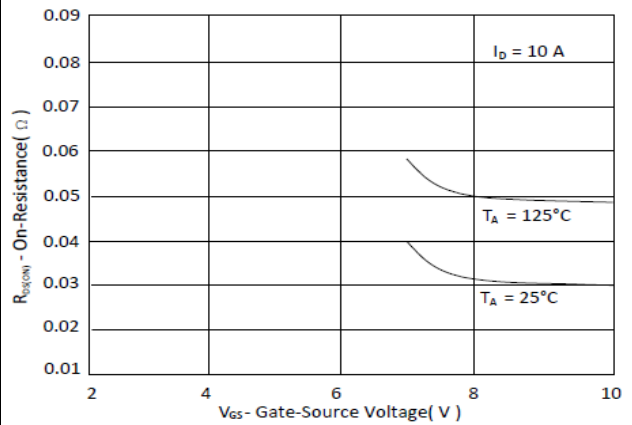


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

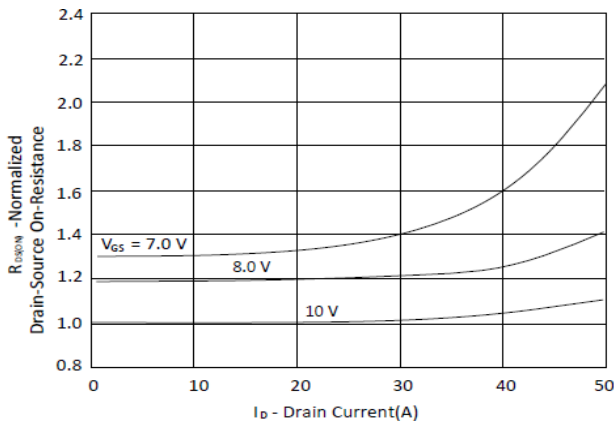


Figure 4. Normalized On-Resistance vs. Junction Temperature

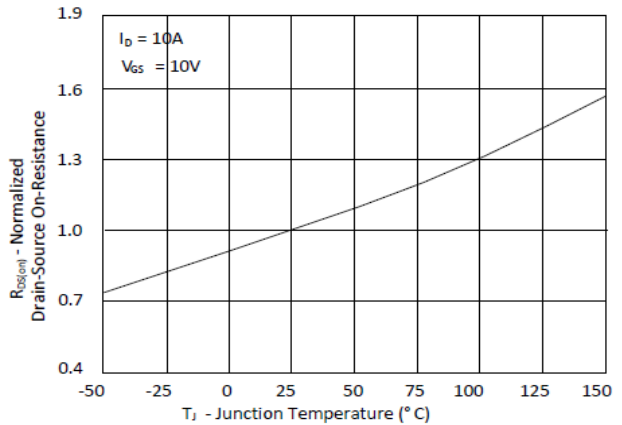


Figure 5. Typical Transfer Characteristics

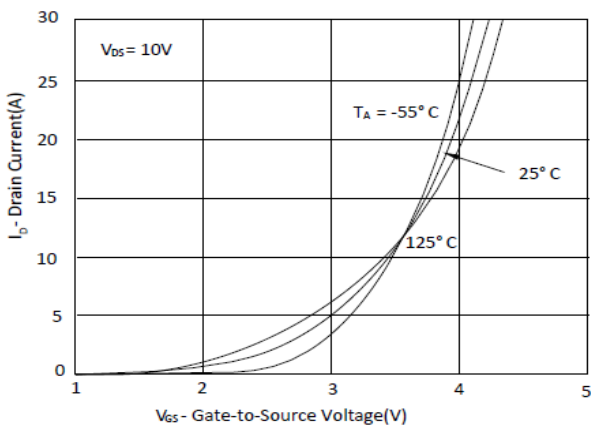


Figure 6. Typical Source-Drain Diode Forward Voltage

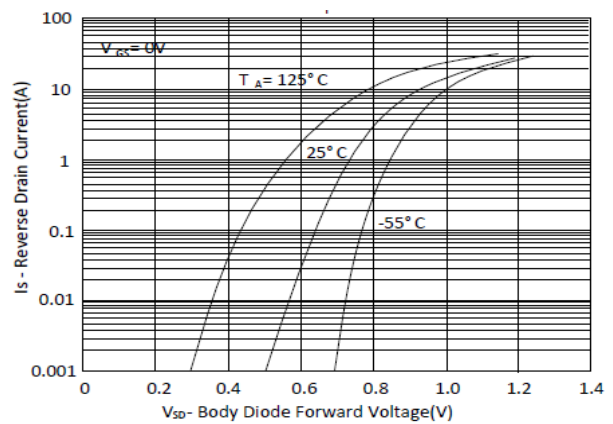


Figure 7. Typical Gate-Charge vs. Gate-to-Source Voltage

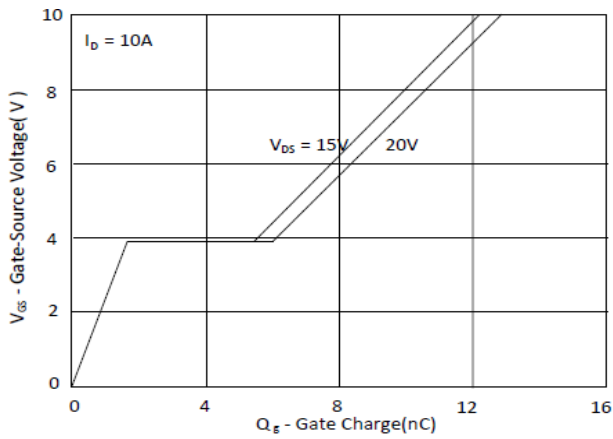


Figure 8. Typical Capacitance vs. Drain-to-Source Voltage

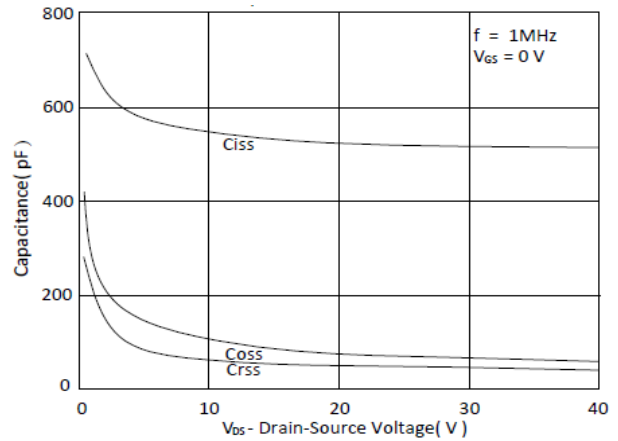


Figure 9. Maximum Safe Operating Area

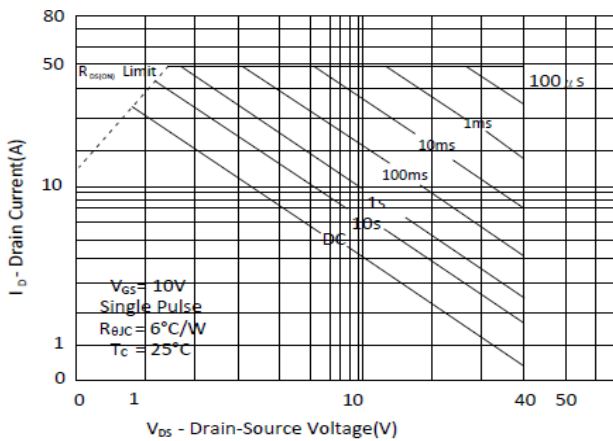


Figure 10. Maximum Drain Current vs. Case Temperature

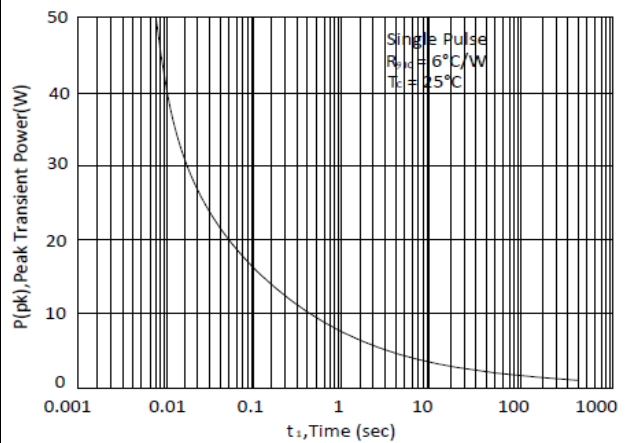
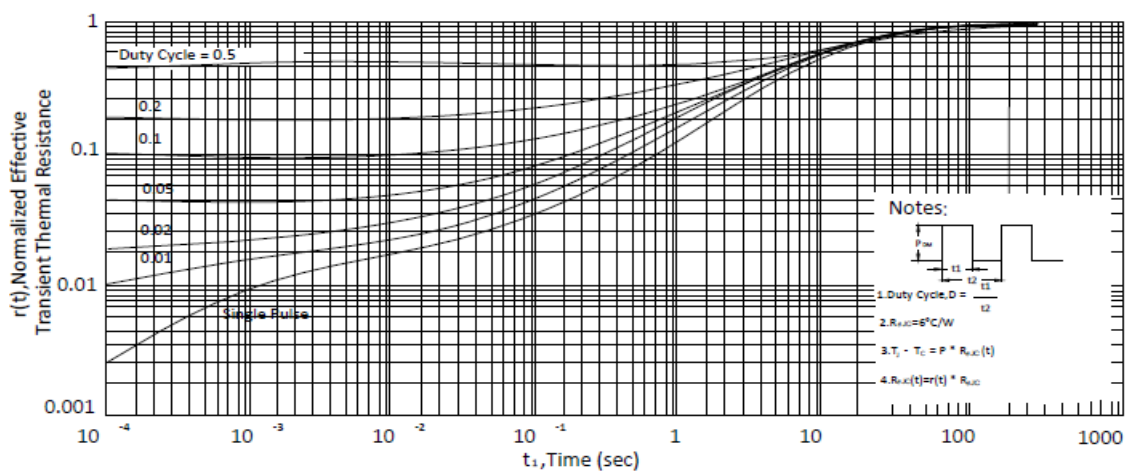
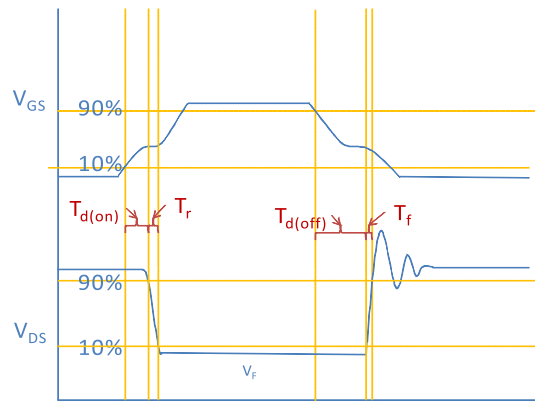
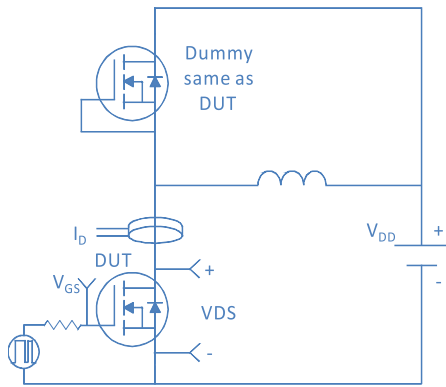


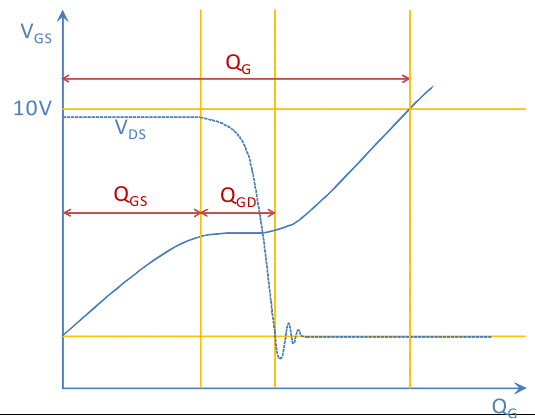
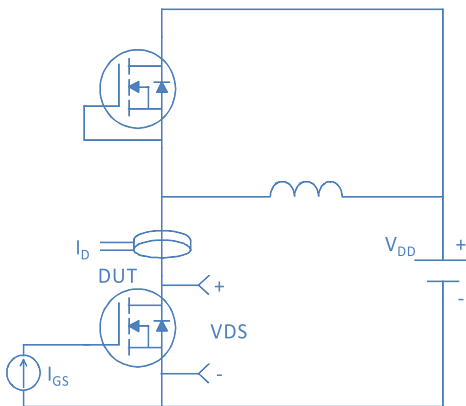
Figure 11. Normalized Maximum Transient Thermal Impedance, Junction-to-Ambient



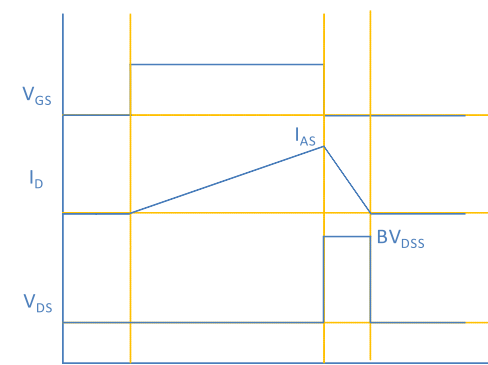
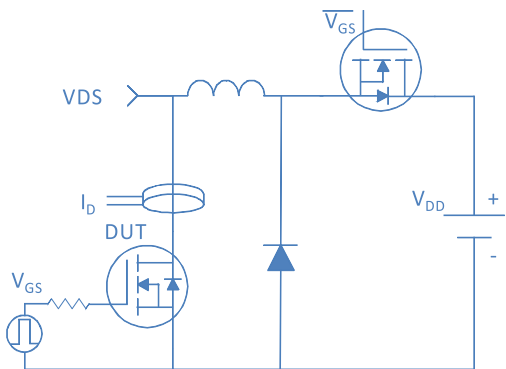
Inductive switching Test



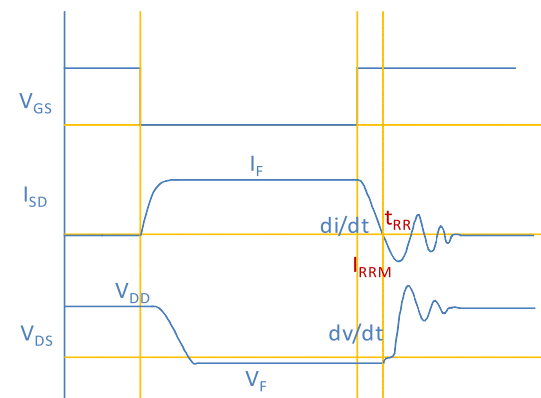
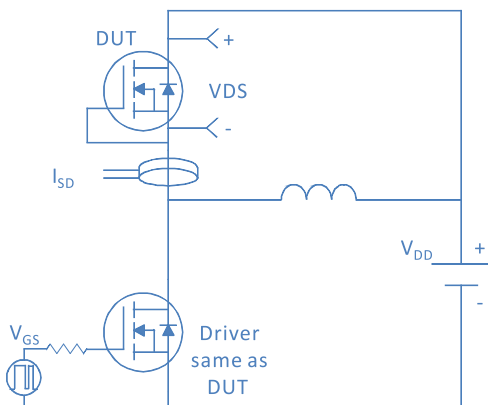
Gate Charge Test



Uclamped Inductive Switching (UIS) Test



Diode Recovery Test



P-Channel Electrical Characteristics at $T_j=25^\circ\text{C}$ (unless otherwise specified)
Static Characteristics

Parameter	Symbol	Conditions	Value			Unit
			min	typ	max	
Drain to Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=250\mu A$	-40	-	-	V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS}=V_{DS}, I_D=250\mu A$	-1.8	-2.3	-3.2	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS}=0V, V_{DS}=-32V, T_j=25^\circ\text{C}$	-	-	-1	μA
		$V_{GS}=0V, V_{DS}=-30V, T_j=125^\circ\text{C}$	-	-	-25	
Gate to Source Leakage Current	I_{GSS}	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	± 100	nA
Drain to Source on Resistance	$R_{DS(on)}$	$V_{GS}=-10V, I_D=-8A$	-	38	44	$m\Omega$
		$V_{GS}=-7V, I_D=-6A$	-	50	70	
Transconductance	g_{fs}	$V_{DS}=-5V, I_D=-8A$	-	11	-	S

Dynamic Characteristics

Input Capacitance	C_{iss}	$V_{GS}=0V, V_{DS}=-20V, f=1\text{MHz}$	-	745	-	pF
Output Capacitance	C_{oss}		-	78	-	
Reverse Transfer Capacitance	C_{rss}		-	58	-	
Total Gate Charge	$Q_g (10V)$	$V_{DD}=-20V, I_D=-10A, V_{GS}=-10V$	-	11.5	-	nC
Gate to Source Charge	Q_{gs}		-	2.5	-	
Gate to Drain (Miller) Charge	Q_{gd}		-	2.8	-	
Turn on Delay Time	$t_{d(on)}$	$V_{DD}=-10V, I_D=-1A, V_{GS}=-10V, R_G=6\Omega,$	-	7	-	ns
Rise time	t_r		-	10	-	
Turn off Delay Time	$t_{d(off)}$		-	20	-	
Fall Time	t_f		-	12	-	

Reverse Diode Characteristics

Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_F=-12A$	-		-1.3	V
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Fig 1. Typical Output Characteristics

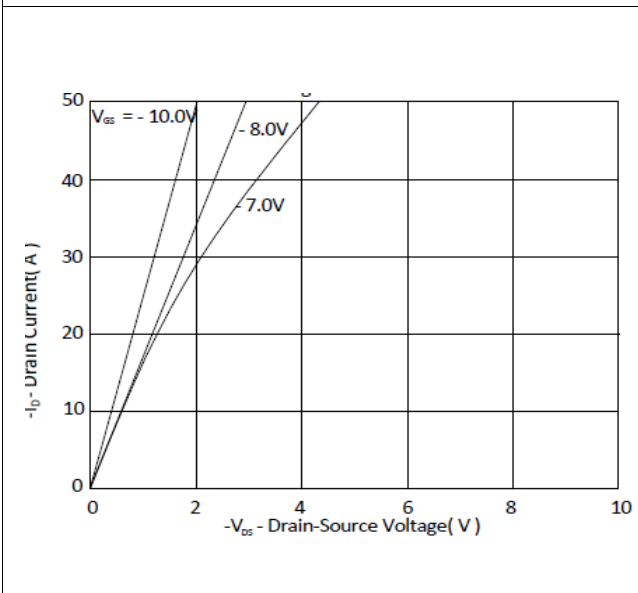


Figure 2. On-Resistance vs. Gate-Source Voltage

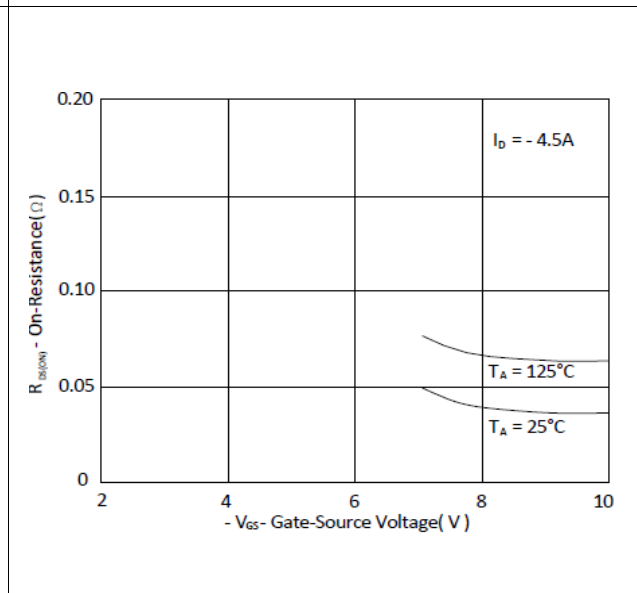


Figure 3. On-Resistance vs. Drain Current and Gate Voltage

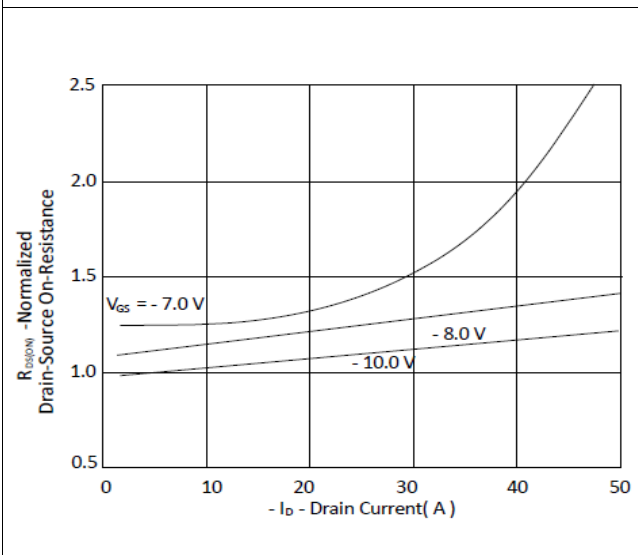


Figure 4. Normalized On-Resistance vs. Junction Temperature

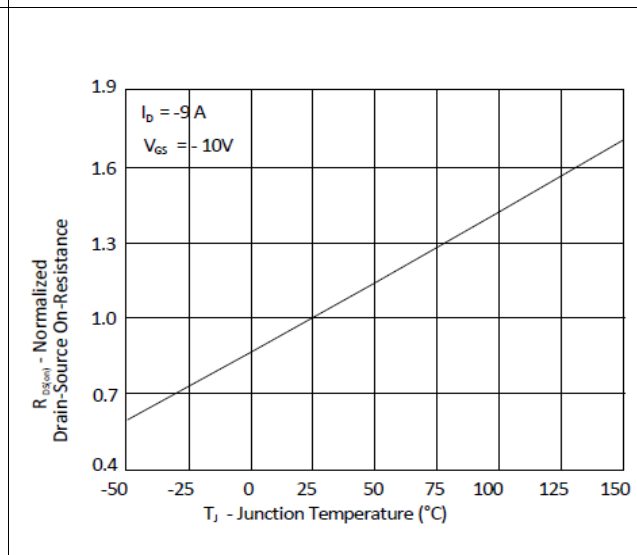


Figure 5. Typical Transfer Characteristics

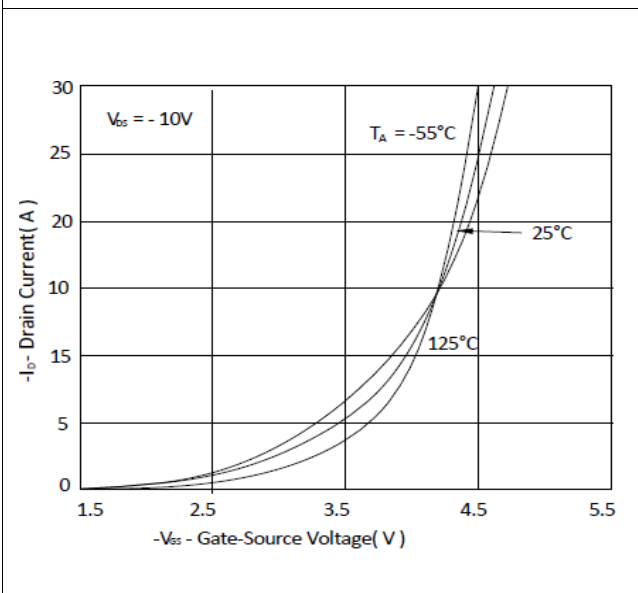


Figure 6. Typical Source-Drain Diode Forward Voltage

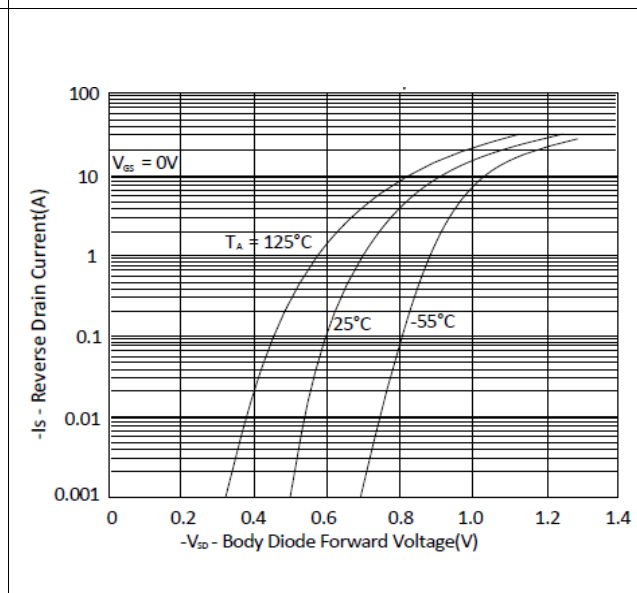


Figure 7. Typical Gate-Charge vs. Gate-to-Source Voltage

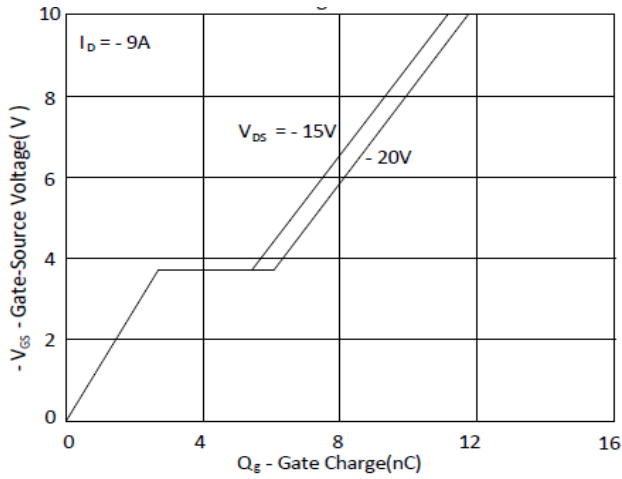


Figure 8. Typical Capacitance vs. Drain-to-Source Voltage

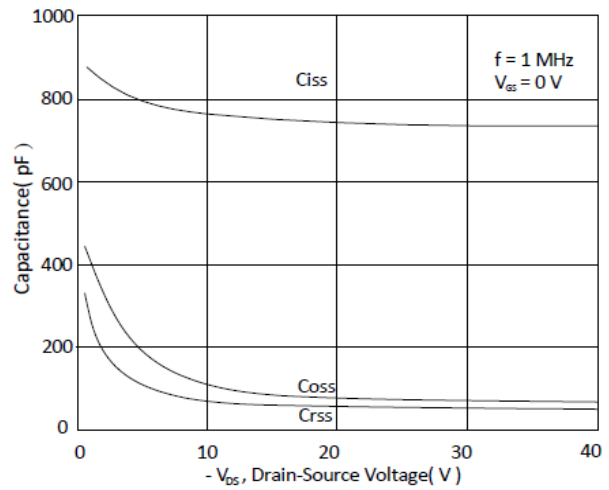


Figure 9. Maximum Safe Operating Area

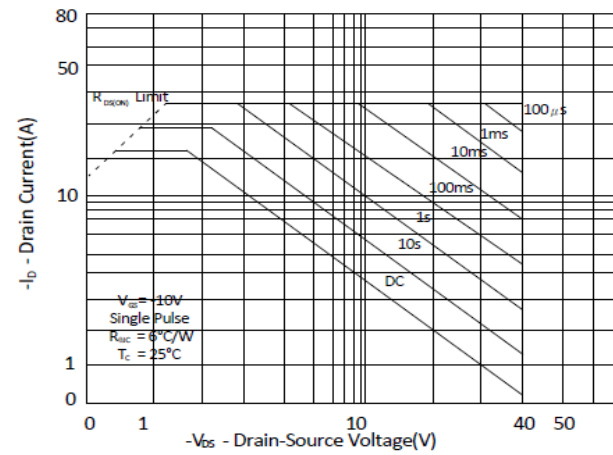


Figure 10. Maximum Drain Current vs. Case Temperature

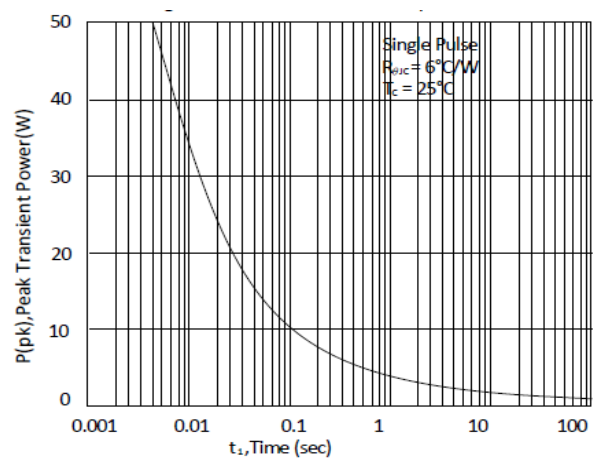
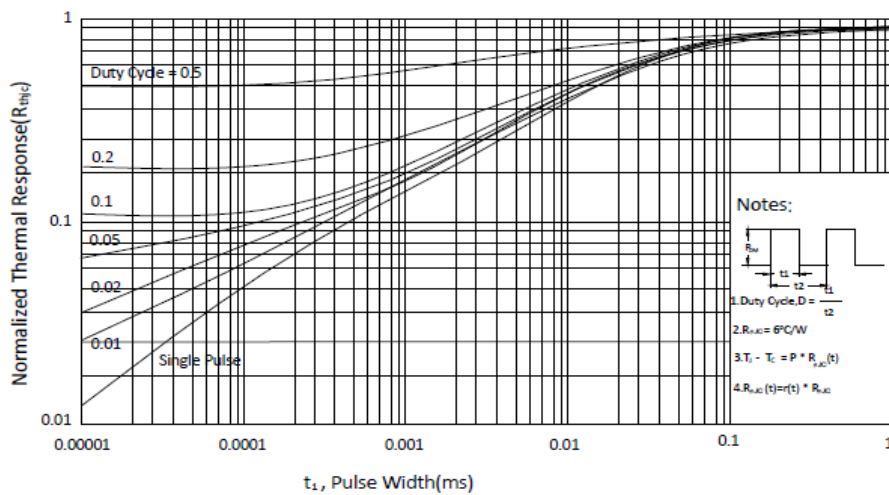
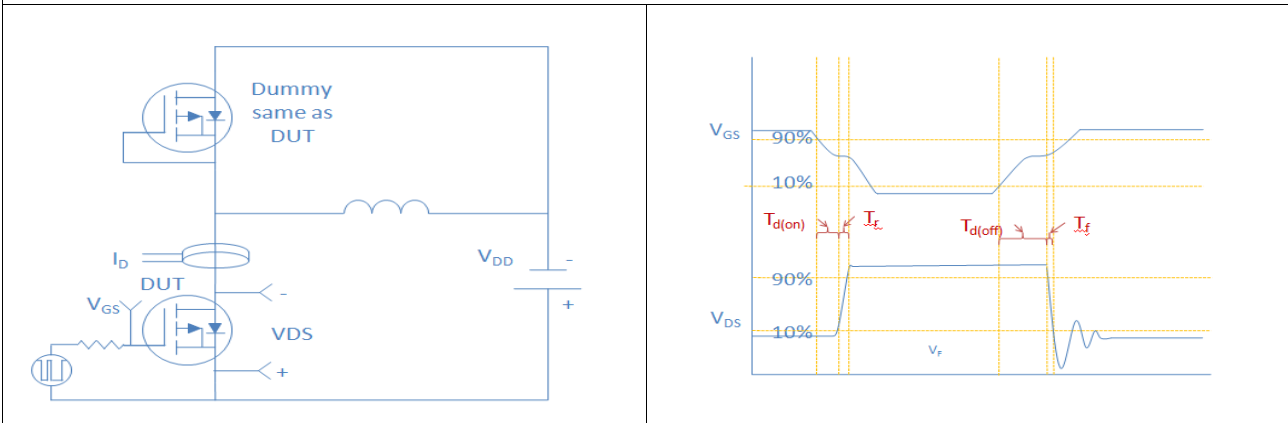


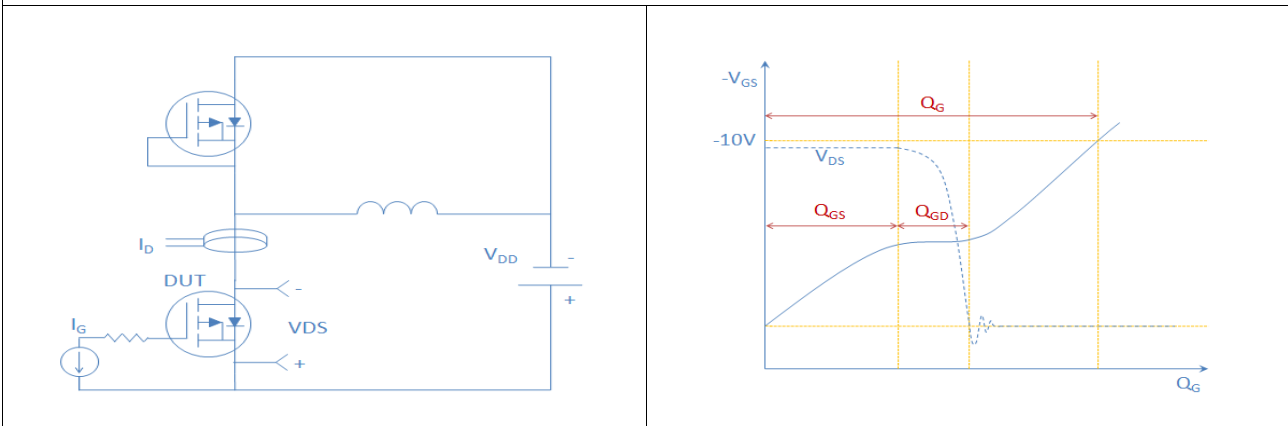
Figure 11. Normalized Maximum Transient Thermal Impedance, Junction-to-Ambient



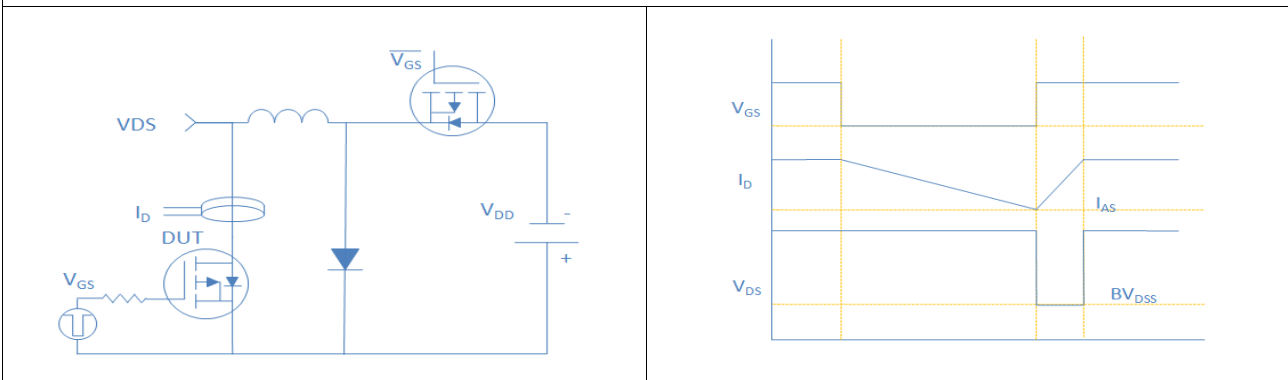
Inductive switching Test



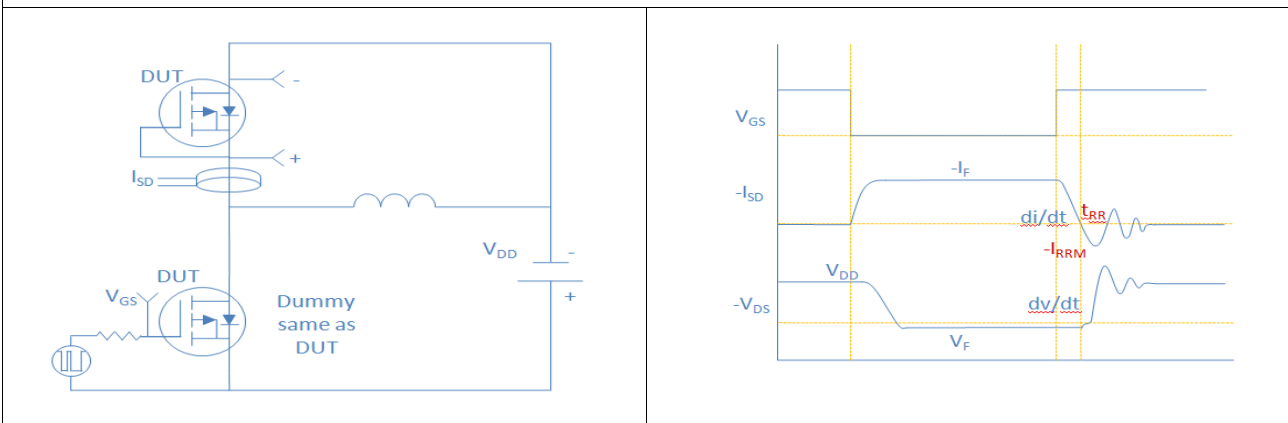
Gate Charge Test



Uclamped Inductive Switching (UIS) Test

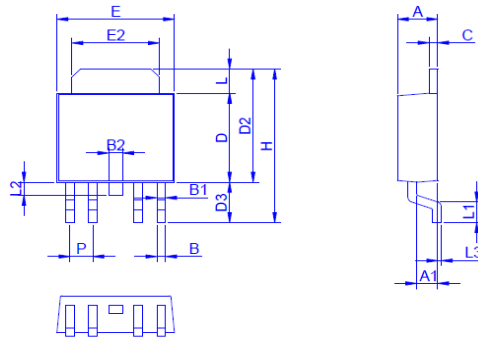


Diode Recovery Test



Package Outline

TO-252, 3leads



Dimension	A	A1	B	B1	B2	C	D	D2	D3	E	E2	H	L	L1	L2	L3	P
Min.	2.10	1.10	0.30	0.55	0.40	0.40	5.30	6.70	2.20	6.30	4.80	9.20	1.30	0.90	0.50	0.00	1.17
Max.	2.50	1.30	0.70	0.75	0.80	0.60	5.70	7.30	3.00	6.70	5.45	10.15	1.70	1.50	1.10	0.30	1.37