AP4513GM

Advanced Power Electronics Corp.

N AND P-CHANNEL ENHANCEMENT

MODE POWER MOSFET

▼ **Simple Drive Requirement**

▼ **Low On-resistance**
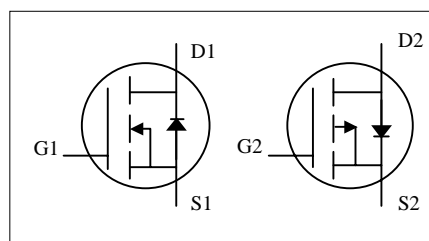
▼ **Fast Switching Performance**

▼ **RoHS Compliant**

SO-8

N-CH	BV_{DSS}	35V
	$R_{DS(ON)}$	36mΩ
	I_D	5.8A
P-CH	BV_{DSS}	-35V
	$R_{DS(ON)}$	68mΩ
	I_D	-4.3A

Description

The Advanced Power MOSFETs from APEC provide the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost-effectiveness.

The SO-8 package is universally preferred for all commercial-industrial surface mount applications and suited for low voltage applications such as DC/DC converters.

Absolute Maximum Ratings

Symbol	Parameter		Rating		Units
			N-channel	P-channel	
V_{DS}	Drain-Source Voltage		35	-35	V
V_{GS}	Gate-Source Voltage		±20	±20	V
I_D@T_A=25℃	Continuous Drain Current[3]		5.8	-4.3	A
I_D@T_A=70℃	Continuous Drain Current[3]		4.7	-3.4	A
I_{DM}	Pulsed Drain Current[1]		20	-20	A
P_D@T_A=25℃	Total Power Dissipation		2		W
	Linear Derating Factor		0.016		W/℃
E_{AS}	Single Pulse Avalanche Energy[4]		12.5	12.5	mJ
I_{AR}	Avalanche Current		5	-5	A
E_{AR}	Repetitive Avalanche Energy[1]		0.05	0.05	mJ
T_{STG}	Storage Temperature Range		-55 to 150		℃
T_J	Operating Junction Temperature Range		-55 to 150		℃

Thermal Data

Symbol	Parameter		Value	Unit
Rthj-a	Thermal Resistance Junction-ambient[3]	Max.	62.5	℃/W

Data and specifications subject to change without notice

AP4513GM

N-CH Electrical Characteristics@T_j=25°C(unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS}=0V, I_D=250uA	35	-	-	V
$\Delta BV_{DSS}/\Delta T_j$	Breakdown Voltage Temperature Coefficient	Reference to 25℃, I_D=1mA	-	0.03	-	V/℃
$R_{DS(ON)}$	Static Drain-Source On-Resistance[2]	V_{GS}=10V, I_D=5A	-	-	36	mΩ
		V_{GS}=4.5V, I_D=3A	-	-	60	mΩ
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS}=V_{GS}, I_D=250uA	1	-	3	V
g_{fs}	Forward Transconductance	V_{DS}=10V, I_D=5A	-	7	-	S
I_{DSS}	Drain-Source Leakage Current (T_j=25°C)	V_{DS}=30V, V_{GS}=0V	-	-	1	uA
	Drain-Source Leakage Current (T_j=70°C)	V_{DS}=24V, V_{GS}=0V	-	-	25	uA
I_{GSS}	Gate-Source Leakage	V_{GS}=±20V	-	-	±100	nA
Q_g	Total Gate Charge[2]	I_D=5A	-	6	10	nC
Q_{gs}	Gate-Source Charge	V_{DS}=28V	-	2	-	nC
Q_{gd}	Gate-Drain ("Miller") Charge	V_{GS}=4.5V	-	3	-	nC
$t_{d(on)}$	Turn-on Delay Time[2]	V_{DS}=15V	-	8	-	ns
t_r	Rise Time	I_D=1A	-	7	-	ns
$t_{d(off)}$	Turn-off Delay Time	R_G=3.3Ω,V_{GS}=10V	-	16	-	ns
t_f	Fall Time	R_D=15Ω	-	3	-	ns
C_{iss}	Input Capacitance	V_{GS}=0V	-	470	750	pF
C_{oss}	Output Capacitance	V_{DS}=25V	-	90	-	pF
C_{rss}	Reverse Transfer Capacitance	f=1.0MHz	-	60	-	pF

Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_{SD}	Forward On Voltage[2]	I_S=1.7A, V_{GS}=0V	-	-	1.2	V
t_{rr}	Reverse Recovery Time	I_S=5A, V_{GS}=0V	-	17	-	ns
Q_{rr}	Reverse Recovery Charge	dI/dt=100A/μs	-	11	-	nC

AP4513GM

P-CH Electrical Characteristics@T$_j$=25°C(unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
BV$_{DSS}$	Drain-Source Breakdown Voltage	V$_{GS}$=0V, I$_D$=-250uA	-35	-	-	V
$\triangle$BV$_{DSS}$/$\triangle$T$_j$	Breakdown Voltage Temperature Coefficient	Reference to 25℃,I$_D$=-1mA	-	-0.03	-	V/℃
R$_{DS(ON)}$	Static Drain-Source On-Resistance^2	V$_{GS}$=-10V, I$_D$=-4A	-	-	68	mΩ
		V$_{GS}$=-4.5V, I$_D$=-2A	-	-	100	mΩ
V$_{GS(th)}$	Gate Threshold Voltage	V$_{DS}$=V$_{GS}$, I$_D$=-250uA	-1	-	-3	V
g$_{fs}$	Forward Transconductance	V$_{DS}$=-10V, I$_D$=-4A	-	6	-	S
I$_{DSS}$	Drain-Source Leakage Current (T=25°C)	V$_{DS}$=-30V, V$_{GS}$=0V	-	-	-1	uA
	Drain-Source Leakage Current (T=70°C)	V$_{DS}$=-24V, V$_{GS}$=0V	-	-	-25	uA
I$_{GSS}$	Gate-Source Leakage	V$_{GS}$=±20V	-	-	±100	nA
Q$_g$	Total Gate Charge^2	I$_D$=-4A	-	6	10	nC
Q$_{gs}$	Gate-Source Charge	V$_{DS}$=-28V	-	1	-	nC
Q$_{gd}$	Gate-Drain ("Miller") Charge	V$_{GS}$=-4.5V	-	4	-	nC
t$_{d(on)}$	Turn-on Delay Time^2	V$_{DS}$=-15V	-	8	-	ns
t$_r$	Rise Time	I$_D$=-1A	-	7	-	ns
t$_{d(off)}$	Turn-off Delay Time	R$_G$=3.3Ω,V$_{GS}$=-10V	-	20	-	ns
t$_f$	Fall Time	R$_D$=15Ω	-	4	-	ns
C$_{iss}$	Input Capacitance	V$_{GS}$=0V	-	410	660	pF
C$_{oss}$	Output Capacitance	V$_{DS}$=-25V	-	95	-	pF
C$_{rss}$	Reverse Transfer Capacitance	f=1.0MHz	-	70	-	pF

Source-Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V$_{SD}$	Forward On Voltage^2	I$_S$=-1.7A, V$_{GS}$=0V	-	-	-1.2	V
t$_{rr}$	Reverse Recovery Time	I$_S$=-4A, V$_{GS}$=0V	-	21	-	ns
Q$_{rr}$	Reverse Recovery Charge	dI/dt=-100A/µs	-	16	-	nC

Notes:

1.Pulse width limited by Max. junction temperature.

2.Pulse width $\leq$300us , duty cycle $\leq$2%.

3.Surface mounted on 1 in^2 copper pad of FR4 board , t $\leq$10sec ; 135℃/W when mounted on min. copper pad.

4.Starting T$_j$=25°C , V$_{DD}$=25V , L=1mH , R$_G$=25Ω
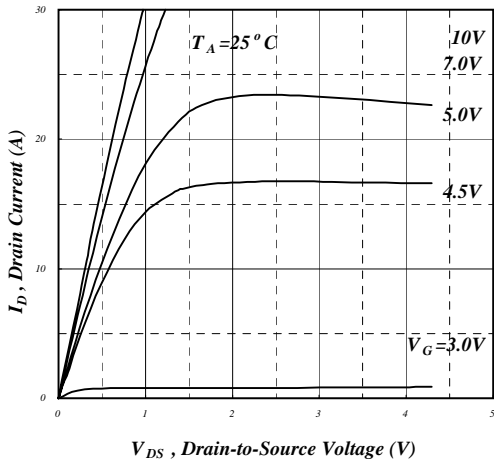
AP4513GM

N-Channel

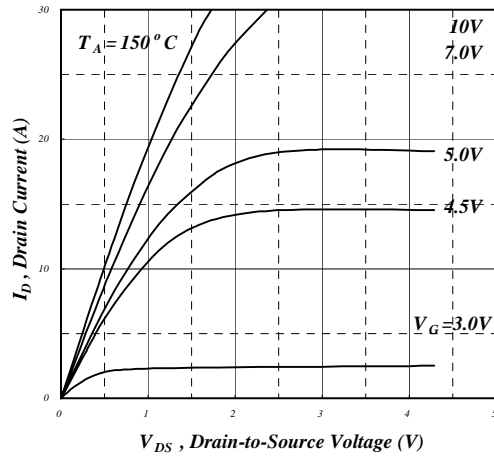

Fig 1. Typical Output Characteristics

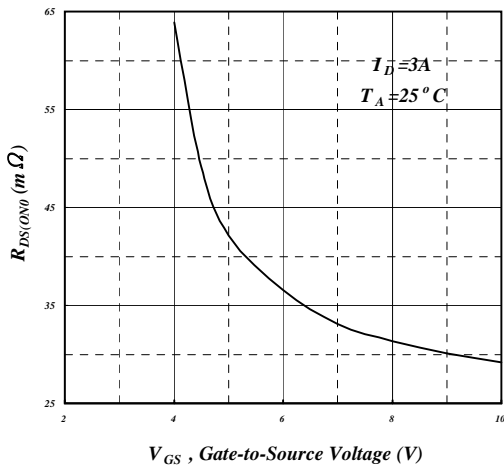Fig 2. Typical Output Characteristics

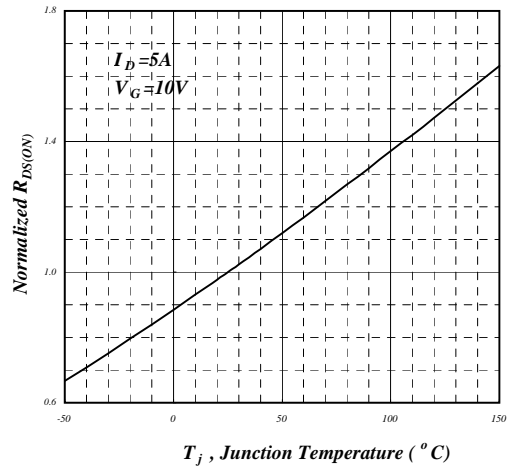Fig 3. On-Resistance v.s. Gate Voltage

Fig 4. Normalized On-Resistance
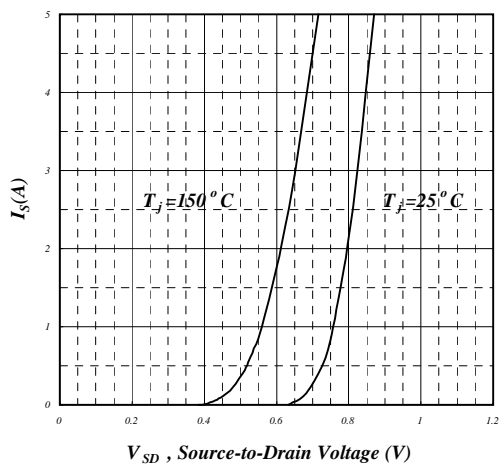v.s. Junction Temperature
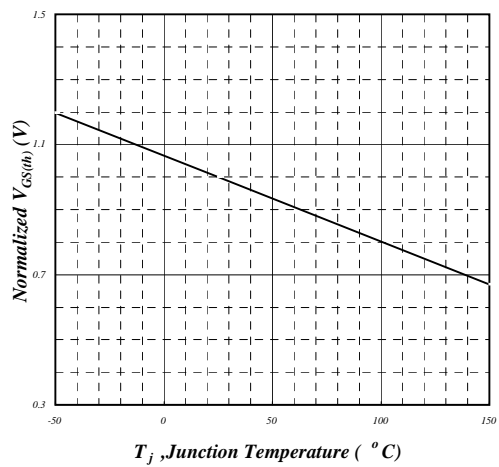

Fig 5. Forward Characteristic of
Reverse Diode

Fig 6. Gate Threshold Voltage v.s.
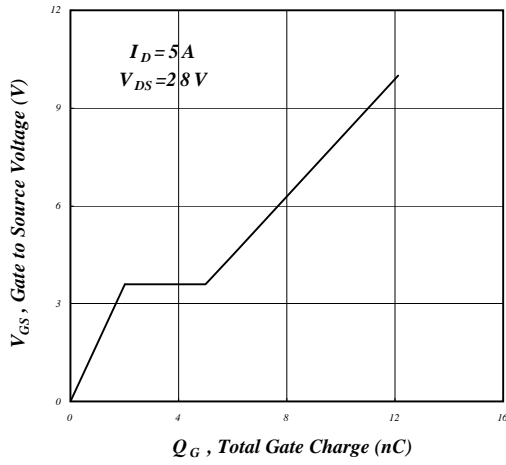Junction Temperature

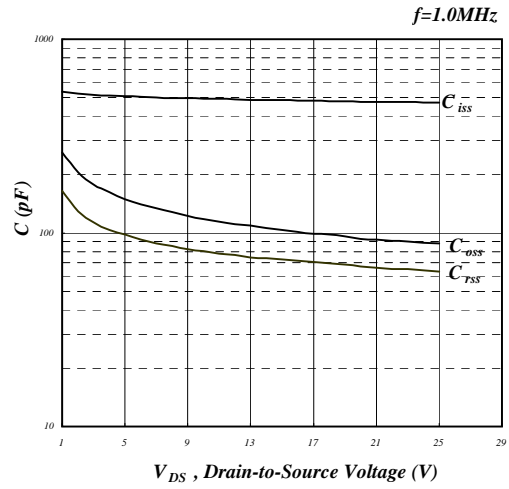**N-Channel**

Fig 7. Gate Charge Characteristics

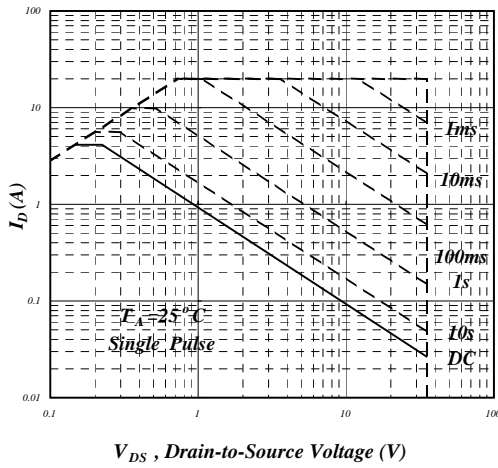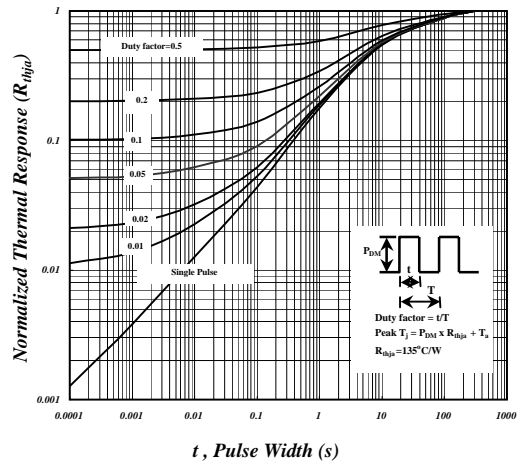Fig 8. Typical Capacitance Characteristics
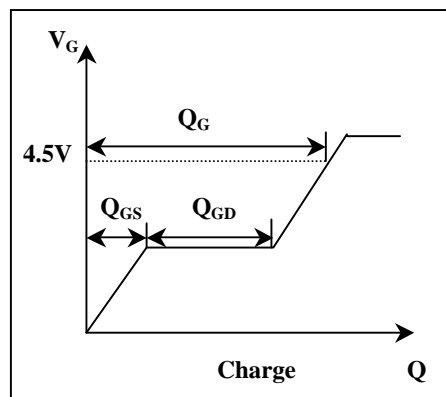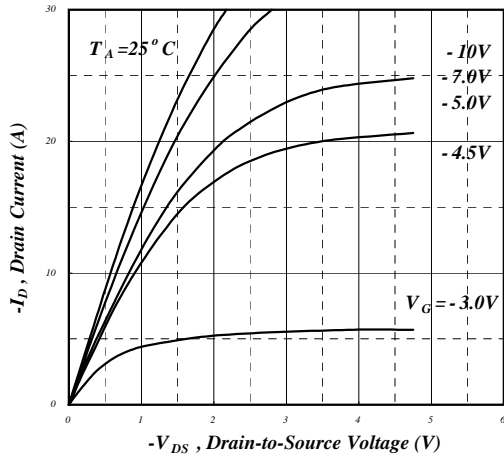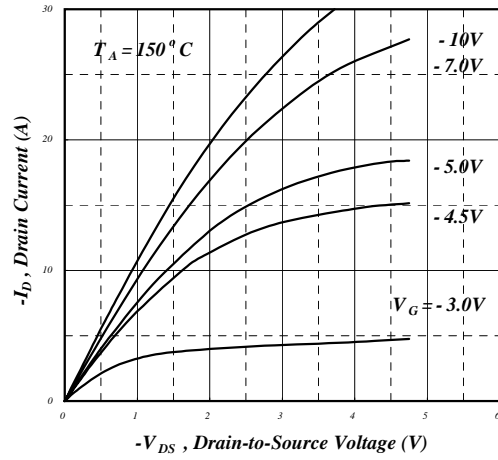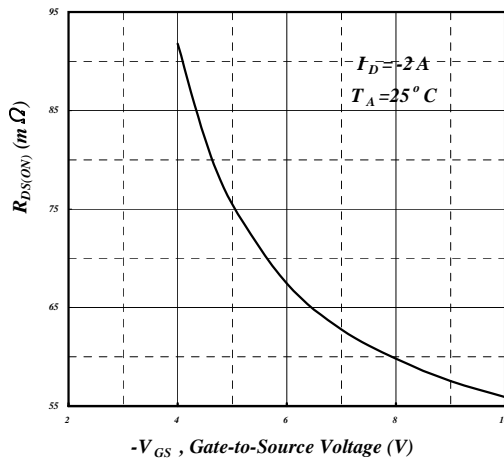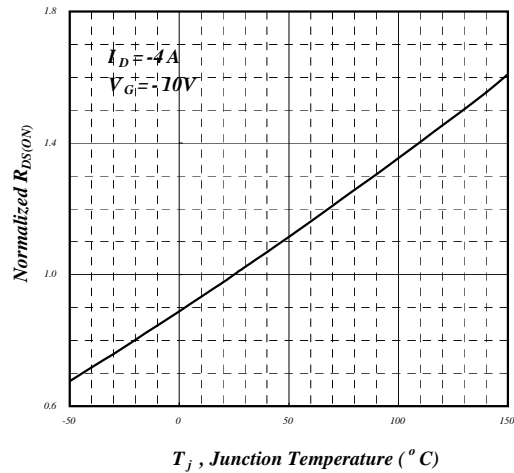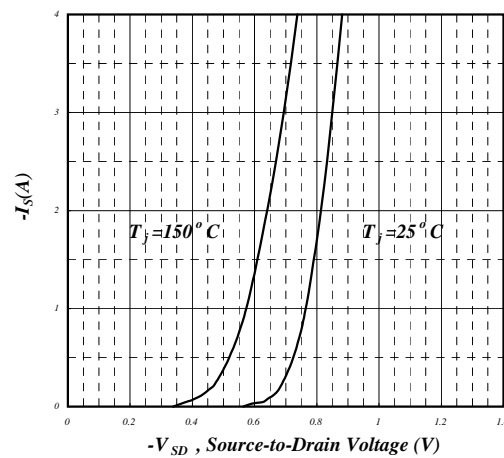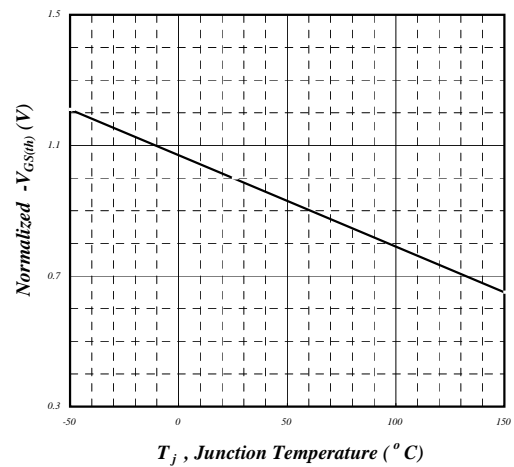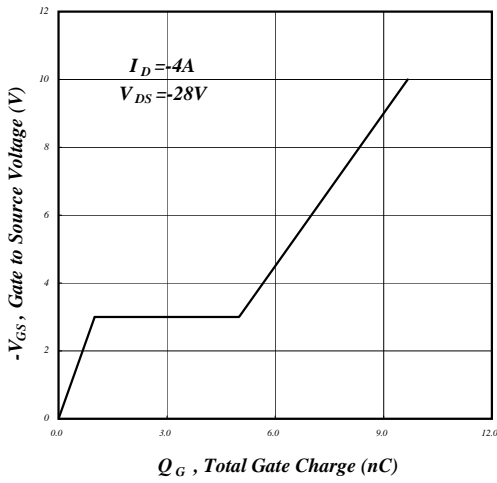

Fig 9. Maximum Safe Operating Area

Fig 10. Effective Transient Thermal Impedance

Fig 11. Switching Time Waveform

Fig 12. Gate Charge Waveform

AP4513GM

P-Channel

Fig 1. Typical Output Characteristics

Fig 2. Typical Output Characteristics

Fig 3. On-Resistance v.s. Gate Voltage

Fig 4. Normalized On-Resistance v.s. Junction Temperature

Fig 5. Forward Characteristic of Reverse Diode

Fig 6. Gate Threshold Voltage v.s. Junction Temperature

P-Channel

$I_D = -4A$
$V_{DS} = -28V$

- V_{GS}, Gate to Source Voltage (V)

Q_G, Total Gate Charge (nC)

Fig 7. Gate Charge Characteristics

$f = 1.0MHz$

C (pF)

C_{iss}

C_{oss}

C_{rss}

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

Fig 8. Typical Capacitance Characteristics

- I_D (A)

1ms
10ms
100ms
1s
10s
DC

$T_A = 25^{\circ}C$
Single Pulse

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

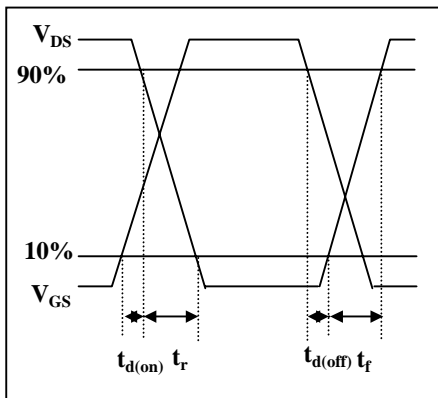**Fig 9. Maximum Safe Operating Area**

Normalized Thermal Response (R_{thja})

Duty factor=0.5
0.2
0.1
0.05
0.02
0.01
Single Pulse

Duty factor = t/T
Peak $T_j = P_{DM}$ x R_{thja} + T_a
R_{thja}=135°C/W

t, Pulse Width (s)

Fig 10. Effective Transient Thermal Impedance

V_{DS}
90%

10%
V_{GS}

$t_{d(on)}$ t_r $t_{d(off)}$ t_f

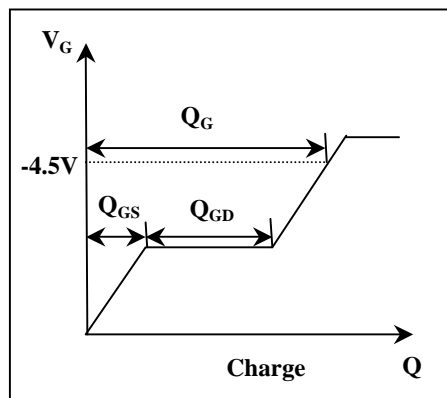**Fig 11. Switching Time Waveform**

V_G

Q_G

-4.5V

Q_{GS} Q_{GD}

Charge   Q

Fig 12. Gate Charge Waveform