

### General Description

Advanced trench MOSFET technology with a low resistance package to provide extremely low  $R_{DS(ON)}$ . one N channel MOSFET and one P channel MOSFET in one package.

### Features

- Advance high cell density Trench technology
- Low  $R_{DS(ON)}$  to minimize conductive loss
- Low Gate Charge for fast switching
- Dual DIE in one package

### Application

- Power Management in Notebook Computer
- BLDC Motor driver

### Ordering Information:

Part NO.	ZMC88404S
Marking	ZMC88404
Packing Information	REEL TAPE
Basic ordering unit (pcs)	4000

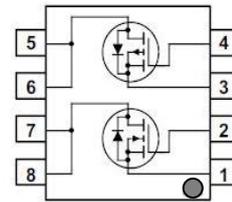
### Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	$R_{thJC}$	-	-	34	° C/W
Thermal resistance, junction - ambient	$R_{thJA}$	-	-	180	° C/W
Soldering temperature, reflow soldering (max)	$T_{sold}$	-	-	260	° C

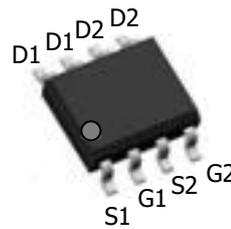
### N Channel Absolute Maximum Ratings ( $T_C = 25^\circ C$ )

Parameter	Symbol	Rating	Unit
Drain-Source Voltage	$V_{DS}$	40	V
Gate-Source Voltage	$V_{GS}$	±20	V
Continuous Drain Current	$I_D @ T_C = 25^\circ C$	6	A
	$I_D @ T_C = 75^\circ C$	4.5	A
	$I_D @ T_C = 100^\circ C$	3.8	A

### Product Summary



$V_{DS1} = 40V$   
 $V_{DS2} = -40V$   
 $R_{DS(ON)1} = 19m\Omega$   
 $R_{DS(ON)2} = 29m\Omega$   
 $I_{D1} = 6A$   
 $I_{D2} = -5A$



SOP8



Pulsed Drain Current <sup>④</sup>	$I_{DM}$	18	A
Total Power Dissipation	$P_D@T_C=25^\circ C$	3.6	W
Total Power Dissipation	$P_D@T_A=25^\circ C$	0.69	W
Operating Junction Temperature	$T_J$	-55 to 150	$^\circ C$
Storage Temperature	$T_{STG}$	-55 to 150	$^\circ C$
Single Pulse Avalanche Energy	$E_{AS}$	27	mJ

### •N Channel Electronic Characteristics

Parameter	Symbol	Condition	Min.	Typ	Max.	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	40			V
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = 250\mu A$	1.4	1.6	2.5	V
Drain-Source Leakage Current	$I_{DSS}$	$V_{DS} = 40V, V_{GS} = 0V$			1.0	$\mu A$
Gate- Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20V, V_{DS} = 0V$			$\pm 100$	nA
Static Drain-source On Resistance	$R_{DS(ON)}$	$V_{GS} = 10V, I_D = 6A$		19	24	$m\Omega$
		$V_{GS} = 4.5V, I_D = 4A$		23	30	$m\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS} = 25V, I_D = 5A$		1.8		S
Source-drain voltage	$V_{SD}$	$I_S = 6A$			1.28	V

### •N Channel Dynamic Characteristics

Parameter	Symbol	Condition	Min.	Typ	Max.	Unit
Input capacitance	$C_{iss}$	$f = 1MHz,$ $V_{DS} = 25V$	-	805	-	pF
Output capacitance	$C_{oss}$		-	94	-	
Reverse transfer capacitance	$C_{rss}$		-	58	-	
Gate Resistance	$R_g$	$f = 1MHz$		1.2		$\Omega$
Total gate charge	$Q_g$	$V_{DD} = 15V$ $I_D = 6A$ $V_{GS} = 10V$	-	12	-	nC
Gate - Source charge	$Q_{gs}$		-	3.1	-	
Gate - Drain charge	$Q_{gd}$		-	2.8	-	
Turn-ON Delay time	$t_{D(on)}$	$V_{GS} = 10V, V_{DS} = 15V$ $R_G = 6\Omega, I_D = 6A$		6		ns
Turn-ON Rise time	$t_r$			16		ns
Turn-Off Delay time	$t_{D(off)}$			28		ns
Turn-Off Fall time	$t_f$			13		ns
Reverse Recovery Time	$t_{RR}$	$V_{DD} = 20V,$ $dI_S/dt = 100A/s,$ $I_S = 6A$		11		ns
Reverse Recovery Charge	$Q_{RR}$			24		nC

**•P Channel Absolute Maximum Ratings (T<sub>C</sub> =25°C)**

Parameter	Symbol	Rating	Unit
Drain-Source Voltage	V <sub>DS</sub>	-40	V
Gate-Source Voltage	V <sub>GS</sub>	±20	V
Continuous Drain Current	I <sub>D</sub> @T <sub>C</sub> =25°C	-5	A
	I <sub>D</sub> @T <sub>C</sub> =75°C	-3.8	A
	I <sub>D</sub> @T <sub>C</sub> =100°C	-3.1	A
Pulsed Drain Current ④	I <sub>DM</sub>	-15	A
Total Power Dissipation	P <sub>D</sub> @T <sub>C</sub> =25°C	3.6	W
Total Power Dissipation	P <sub>D</sub> @T <sub>A</sub> =25°C	0.69	W
Operating Junction Temperature	T <sub>J</sub>	-55 to 150	°C
Storage Temperature	T <sub>STG</sub>	-55 to 150	°C
Single Pulse Avalanche Energy	E <sub>AS</sub>	35	mJ

**•P Channel Electronic Characteristics**

Parameter	Symbol	Condition	Min.	Typ	Max.	Unit
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =-250uA	-40			V
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =-250uA	-1.4		-2.5	V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =-40V, V <sub>GS</sub> =0V			-1.0	uA
Gate- Source Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V			±100	nA
Static Drain-source On Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =-10V, I <sub>D</sub> =-5A		29	36	mΩ
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-4A		38	49	mΩ
Forward Transconductance	g <sub>FS</sub>	V <sub>DS</sub> =-10V, I <sub>D</sub> =-4A		1.2		s
Source-drain voltage	V <sub>SD</sub>	I <sub>S</sub> =-5A			1.28	V

**•P Channel Dynamic Characteristics**

Parameter	Symbol	Condition	Min.	Typ	Max.	Unit
Input capacitance	C <sub>iss</sub>	f = 1MHz, V <sub>DS</sub> =25V	-	1590	-	pF
Output capacitance	C <sub>oss</sub>		-	128	-	pF
Reverse transfer capacitance	C <sub>rss</sub>		-	94	-	pF
Gate Resistance	R <sub>g</sub>	f = 1MHz		9.3		Ω
Total gate charge	Q <sub>g</sub>	V <sub>DD</sub> = 15V I <sub>D</sub> = 5A V <sub>GS</sub> = 10V	-	24	-	nC
Gate - Source charge	Q <sub>gs</sub>		-	4.4	-	nC
Gate - Drain charge	Q <sub>gd</sub>		-	4.8	-	nC

Turn-ON Delay time	$t_{D(on)}$	$V_{GS}=10V,$ $V_{DS}=15V$ $R_G =6\Omega,$ $I_D =5A$	13.2	ns
Turn-ON Rise time	$t_r$		5.5	ns
Turn-Off Delay time	$t_{D(off)}$		42	ns
Turn-Off Fall time	$t_f$		47	ns
Reverse Recovery Time	$t_{RR}$	$V_{DD} = 20 V,$ $dI_S/dt = 100$ $A/s, I_S = 5 A$	21	ns
Reverse Recovery Charge	$Q_{RR}$		24	nC

**•N Channel characteristics curve**

Fig.1 Power Dissipation Derating Curve

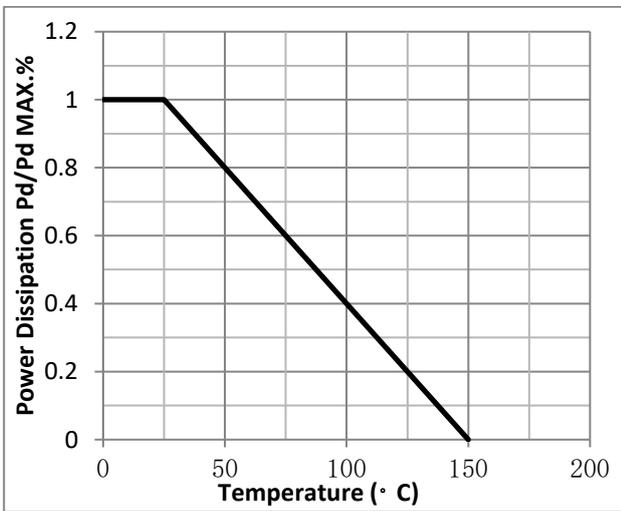


Fig.2 Typical output Characteristics

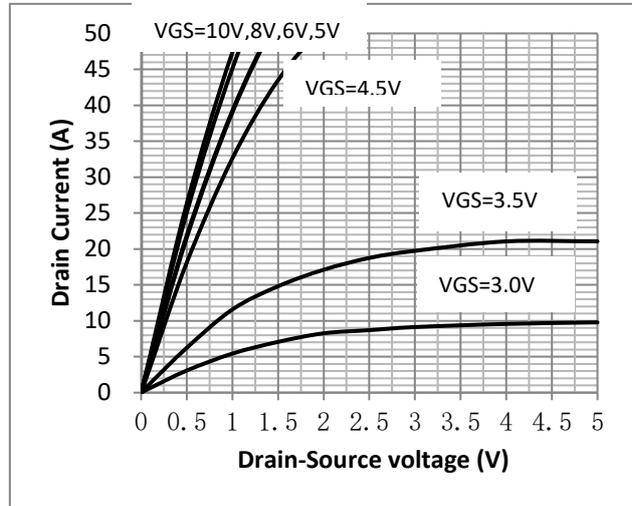


Fig.3 Threshold Voltage V.S Junction Temperature

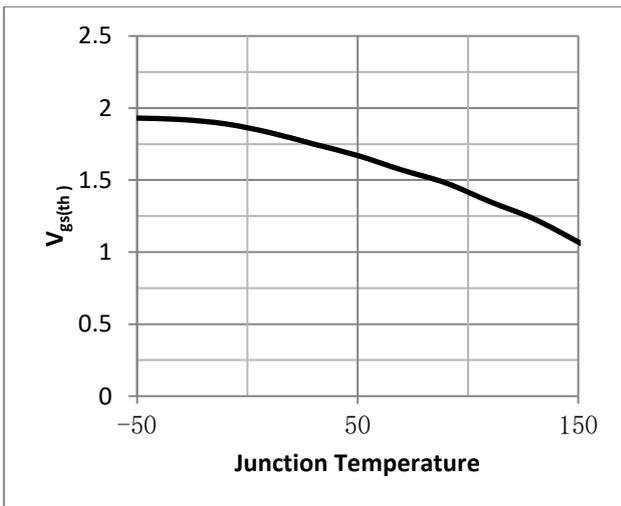


Fig.4 Resistance V.S Drain Current

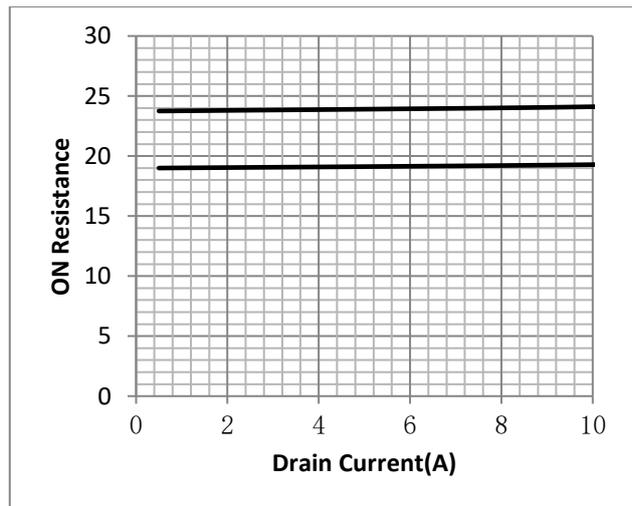


Fig.5 On-Resistance VS Gate Source Voltage

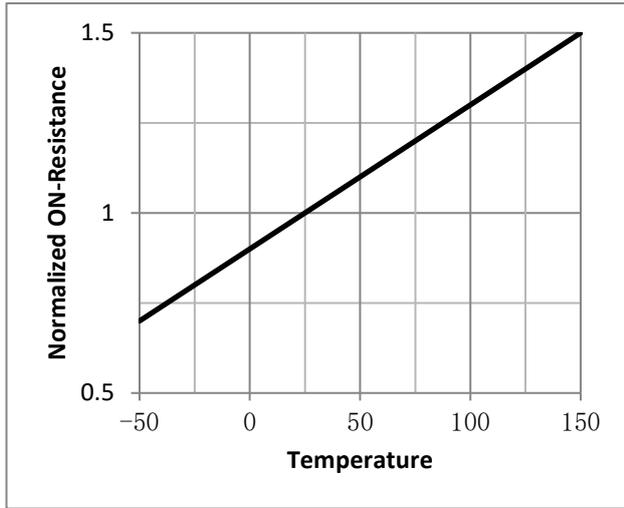


Fig.6 On-Resistance V.S Junction Temperature

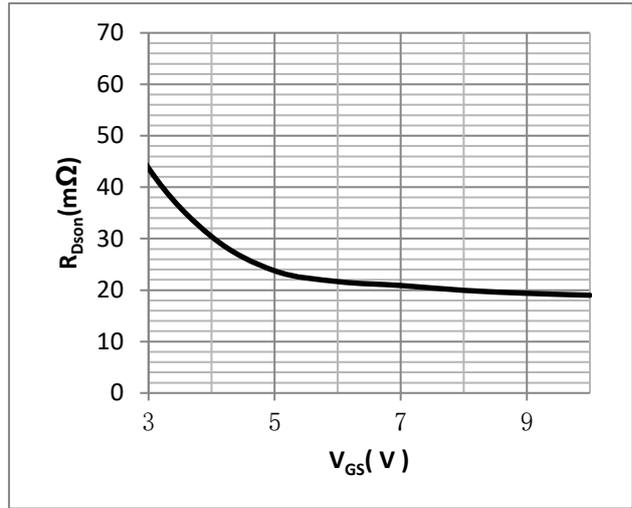


Fig.7 SOA Maximum Safe Operating Area

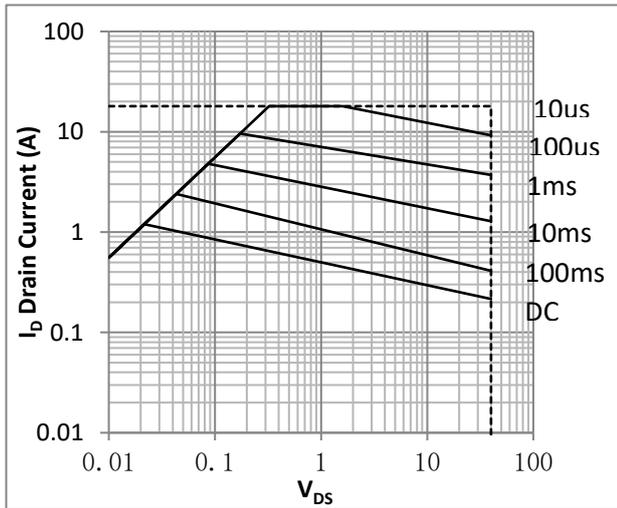


Fig.8 ID-Junction Temperature

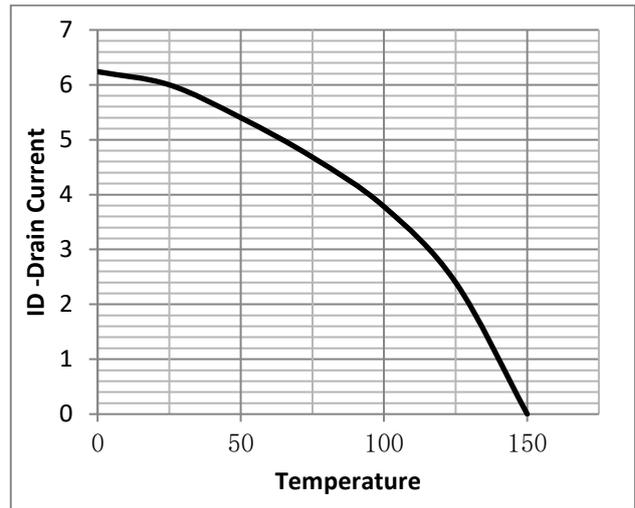


Figure 9. Diode Forward Voltage vs. Current

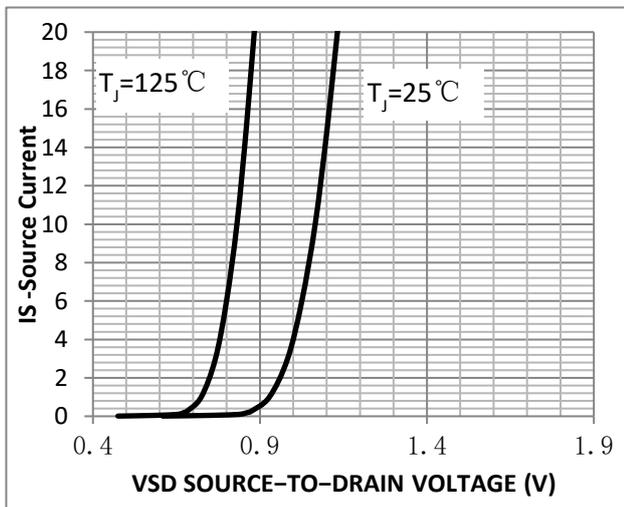


Figure 10. Transfer Characteristics

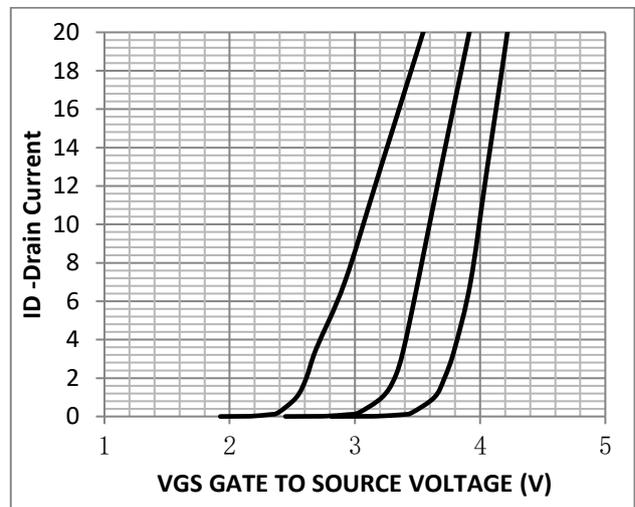


Figure 11. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

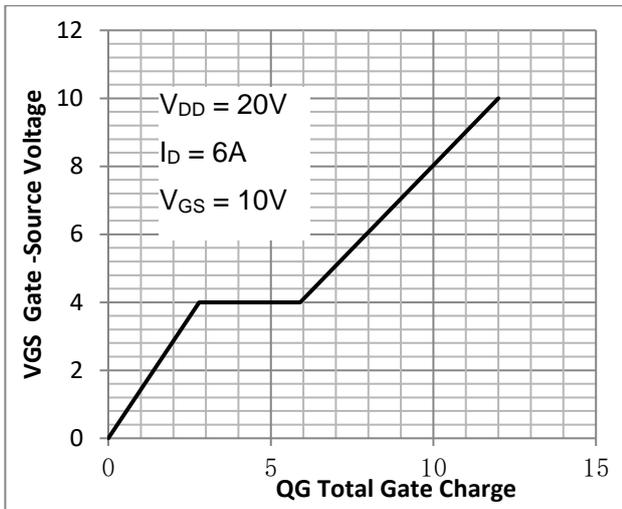
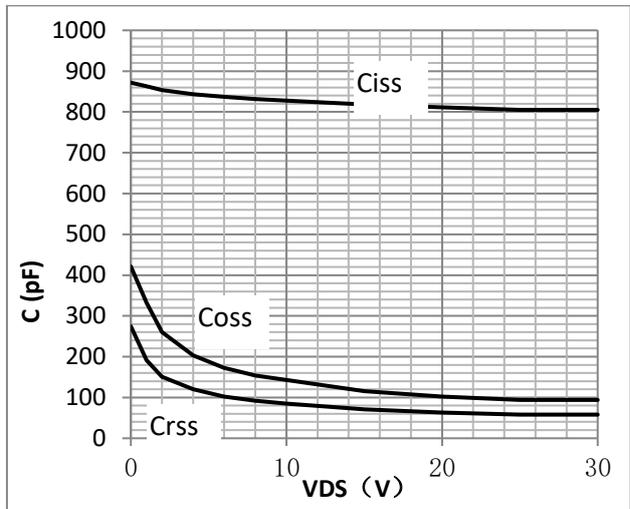


Fig.12 Capacitance Variation



•P Channel characteristics curve

Fig.1 Power Dissipation Derating Curve

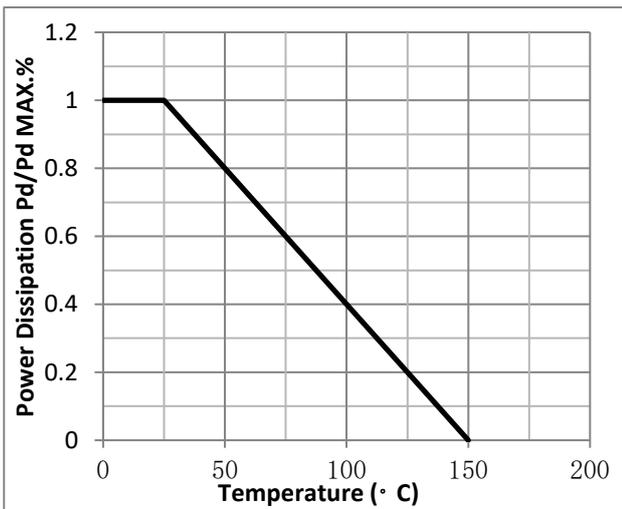


Fig.2 Typical output Characteristics

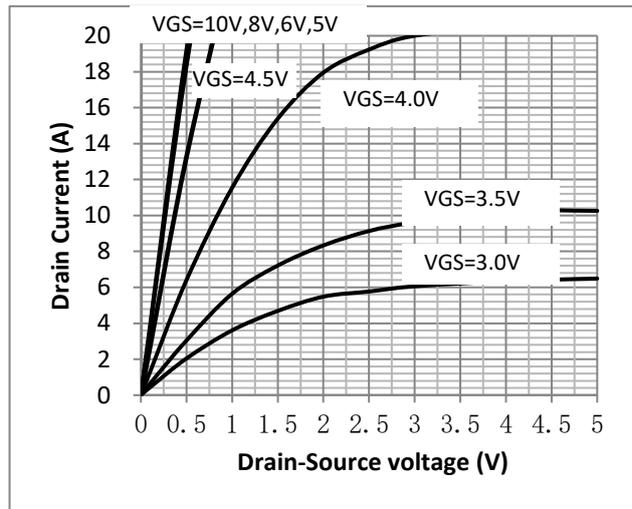


Fig.3 Threshold Voltage V.S Junction Temperature

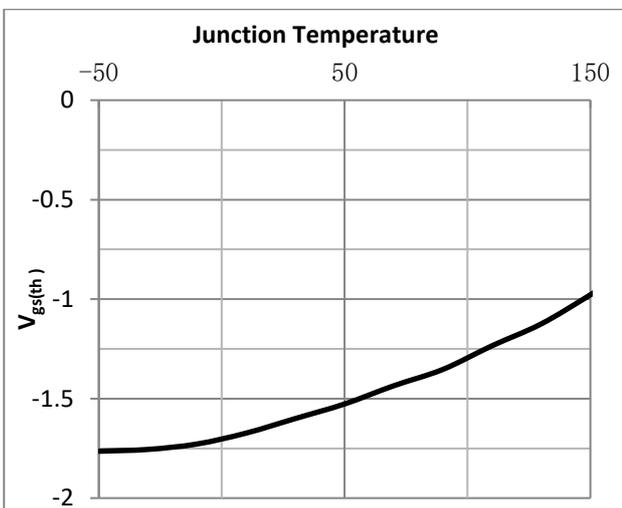


Fig.4 Resistance V.S Drain Current

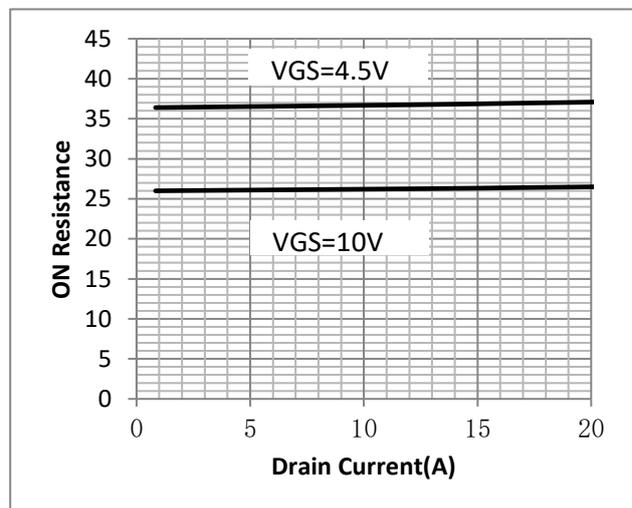


Fig.5 On-Resistance VS Gate Source Voltage

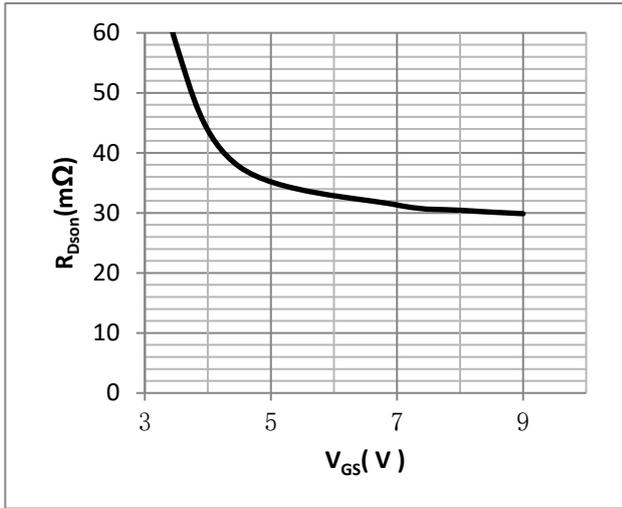


Fig.6 On-Resistance V.S Junction Temperature

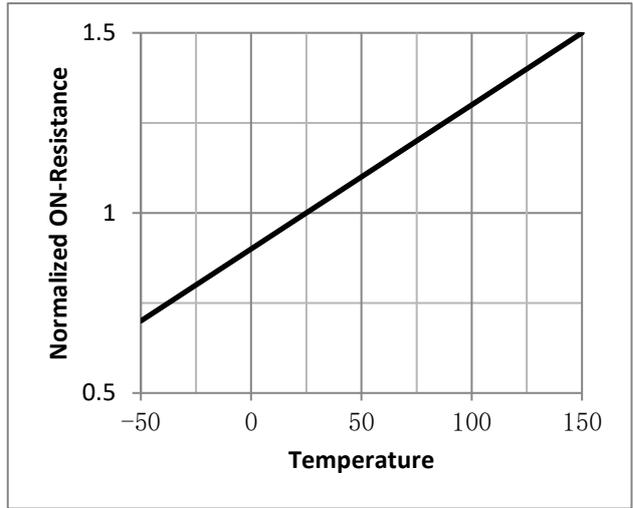


Fig.7 SOA Maximum Safe Operating Area

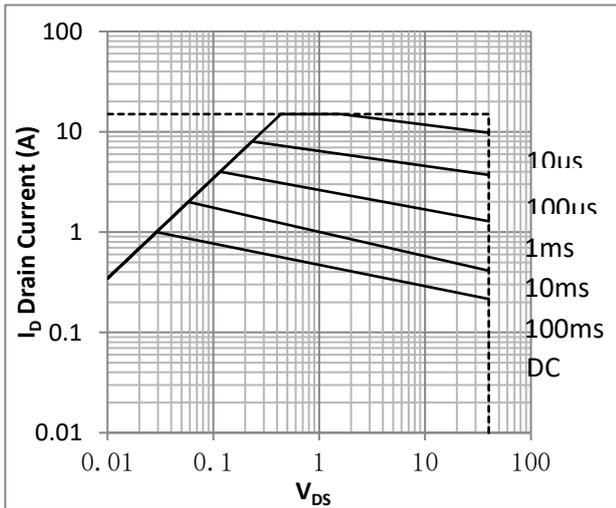


Fig.8 ID-Junction Temperature

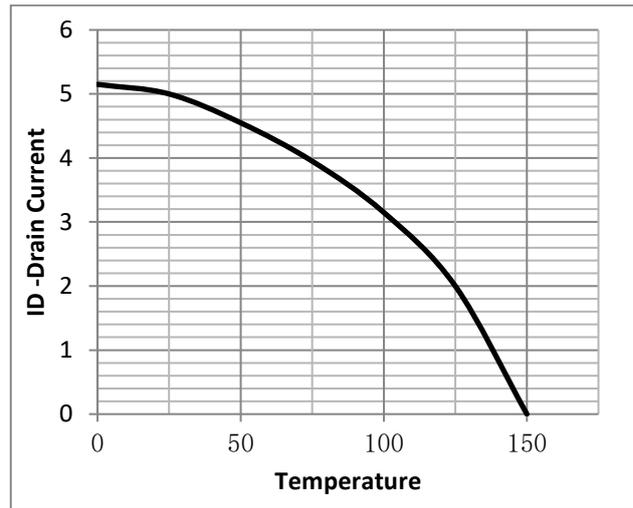


Figure 9. Diode Forward Voltage vs. Current

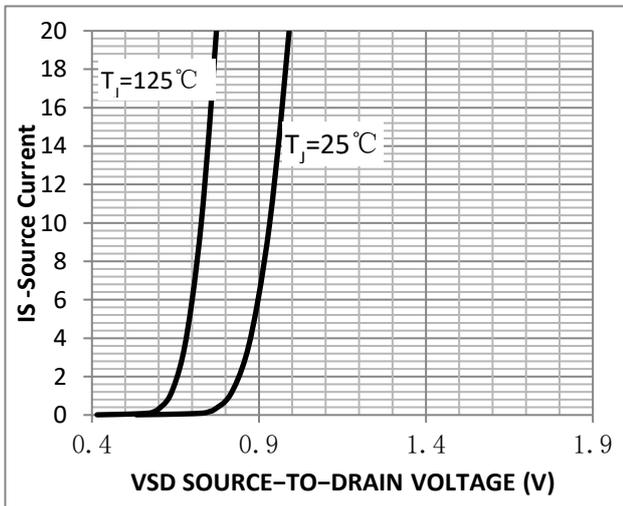


Figure 10. Transfer Characteristics

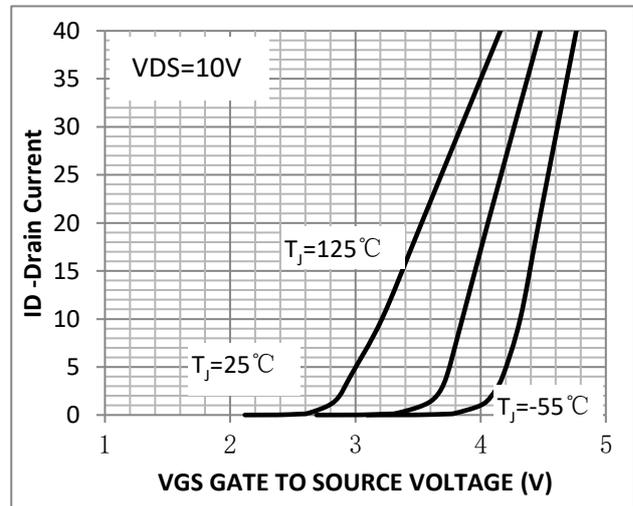


Figure 11. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

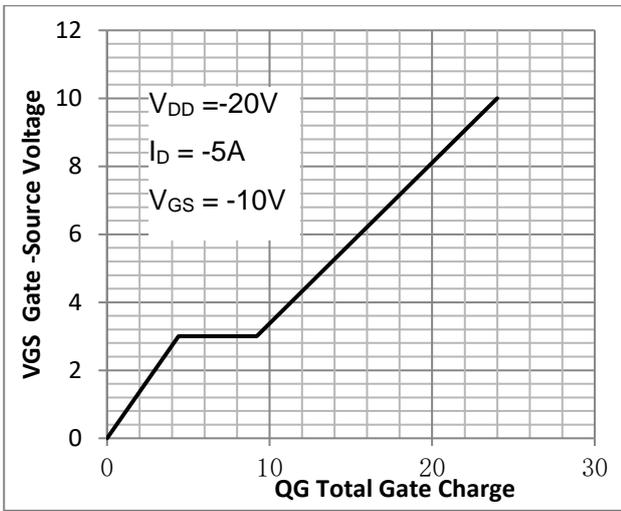
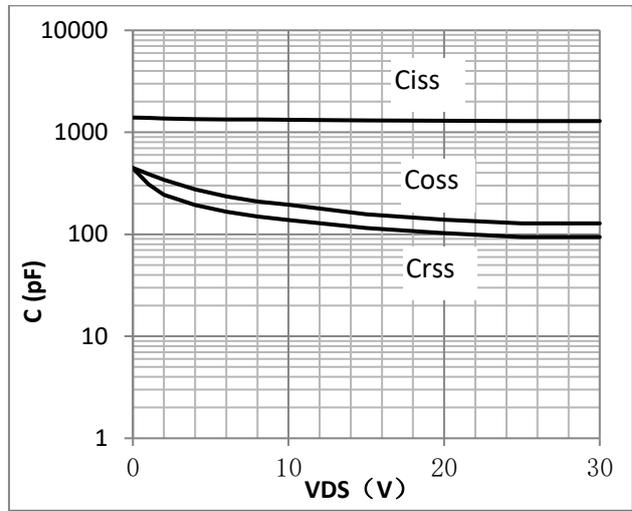


Fig.12 Capacitance Variation



• Test Circuit

Fig.1 Switching Time Measurement Circuit

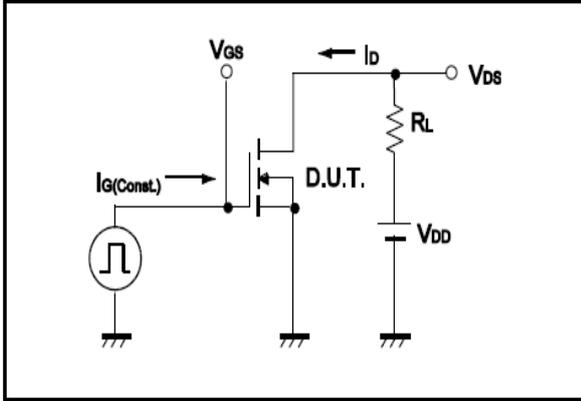


Fig.2 Gate Charge Waveform

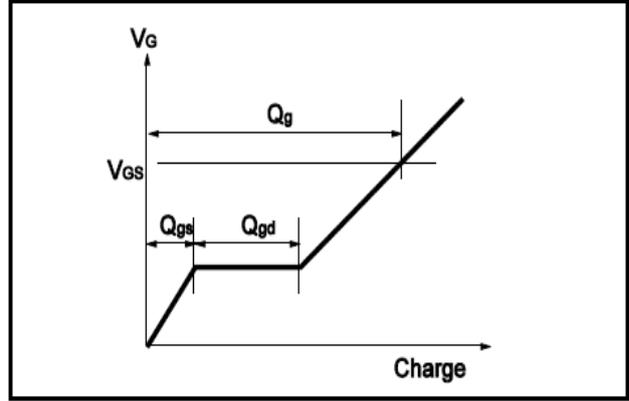


Fig.3 Switching Time Measurement Circuit

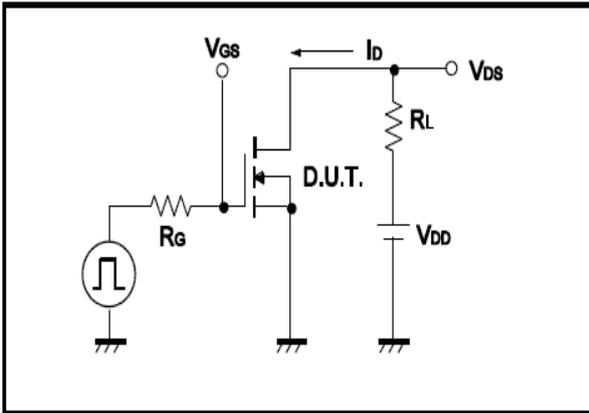


Fig.4 Gate Charge Waveform

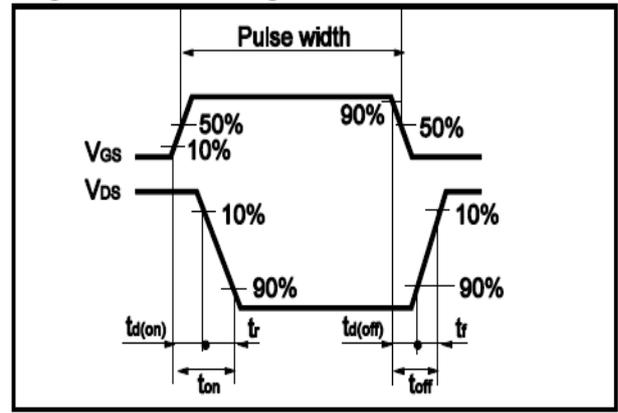


Fig.5 Avalanche Measurement Circuit

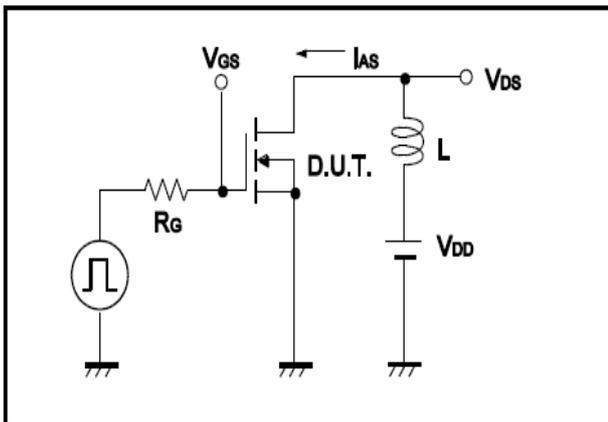
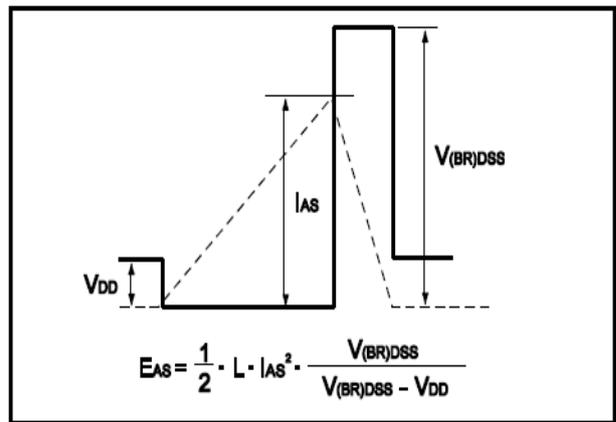


Fig.6 Avalanche Waveform



●Dimensions(SOP8)

Unit: mm

SYMBOL	min	TYP	max	SYMBOL	min		max
A	4.80		5.25	C	1.30		1.75
A1	0.37		0.49	C1	0.55		0.75
A2		1.27		C2	0.55		0.65
A3		0.41		C3	0.05		0.20
B	5.80		6.20	C4	0.10	0.20	0.23
B1	3.80		4.10	D		1.05	
B2		5.00		D1	0.40		0.62

