R5021ANX

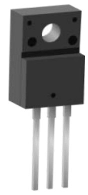
Nch 500V 21A Power MOSFET

Datasheet

V_{DSS}	500V
$R_{DS(on)}$ (Max.)	0.21Ω
I_D	21A
P_D	50W

●Outline

TO-220FM



(1)(2)(3)

●Features

1) Low on-resistance.

2) Fast switching speed.

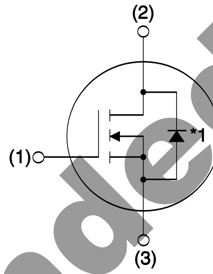
3) Gate-source voltage (V_{GSS}) guaranteed to be ±30V.

4) Drive circuits can be simple.

5) Parallel use is easy.

6) Pb-free lead plating ; RoHS compliant

●Inner circuit



(1) Gate
(2) Drain
(3) Source

*1 Body Diode

●Application

Switching Power Supply

●Packaging specifications

Type	Packaging	Bulk
	Reel size (mm)	-
	Tape width (mm)	-
	Basic ordering unit (pcs)	500
	Taping code	-
	Marking	R5021ANX

●Absolute maximum ratings(T_a = 25°C)

Parameter		Symbol	Value	Unit
Drain - Source voltage		V_{DSS}	500	V
Continuous drain current	T_c = 25°C	I_D *1	±21	A
	T_c = 100°C	I_D *1	±10.1	A
Pulsed drain current		$I_{D,pulse}$ *2	±84	A
Gate - Source voltage		V_{GSS}	±30	V
Avalanche energy, single pulse		E_{AS} *3	29.6	mJ
Avalanche energy, repetitive		E_{AR} *4	3.5	mJ
Avalanche current		I_{AR} *3	10.5	A
Power dissipation (T_c = 25°C)		P_D	50	W
Junction temperature		T_j	150	°C
Range of storage temperature		T_{stg}	–55 to +150	°C
Reverse diode dv/dt		dv/dt *5	15	V/ns

●Absolute maximum ratings

Parameter	Symbol	Conditions	Values	Unit
Drain - Source voltage slope	dv/dt	V_{DS} = 400V, I_D = 21A T_j = 125°C	50	V/ns

●Thermal resistance

Parameter	Symbol	Values Min.	Values Typ.	Values Max.	Unit
Thermal resistance, junction - case	R_{thJC}	-	-	2.5	°C/W
Thermal resistance, junction - ambient	R_{thJA}	-	-	70	°C/W
Soldering temperature, wavesoldering for 10s	T_{sold}	-	-	265	°C

●Electrical characteristics(Ta = 25°C)

Parameter	Symbol	Conditions	Values Min.	Values Typ.	Values Max.	Unit
Drain - Source breakdown voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 1mA	500	-	-	V
Drain - Source avalanche breakdown voltage	$V_{(BR)DS}$	V_{GS} = 0V, I_D = 21A	-	580	-	V
Zero gate voltage drain current	I_{DSS}	V_{DS} = 500V, V_{GS} = 0V T_j = 25°C T_j = 125°C	- -	0.1 -	100 1000	μA
Gate - Source leakage current	I_{GSS}	V_{GS} = ±30V, V_{DS} = 0V	-	-	±100	nA
Gate threshold voltage	$V_{GS (th)}$	V_{DS} = 10V, I_D = 1mA	2.5	-	4.5	V
Static drain - source on - state resistance	$R_{DS(on)}$ *6	V_{GS} = 10V, I_D = 10.5A T_j = 25°C T_j = 125°C	- -	0.16 0.33	0.21 -	Ω
Gate input resistance	R_G	f = 1MHz, open drain	-	11.6	-	Ω

●Electrical characteristics(Ta = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Transconductance	g_{fs} *6	V_{DS} = 10V, I_D = 10.5A	7	15	-	S
Input capacitance	C_{iss}	V_{GS} = 0V	-	2300	-	pF
Output capacitance	C_{oss}	V_{DS} = 25V	-	1000	-	pF
Reverse transfer capacitance	C_{rss}	f = 1MHz	-	70	-	pF
Effective output capacitance, energy related	$C_{o(er)}$	V_{GS} = 0V, V_{DS} = 0V to 400V	-	143	-	pF
Effective output capacitance, time related	$C_{o(tr)}$	V_{GS} = 0V, V_{DS} = 0V to 400V	-	146	-	pF
Turn - on delay time	$t_{d(on)}$ *6	V_{DD} ≃ 250V, V_{GS} = 10V	-	47	-	ns
Rise time	t_r *6	I_D = 10.5A	-	70	-	ns
Turn - off delay time	$t_{d(off)}$ *6	R_L = 23.8Ω	-	200	400	ns
Fall time	t_f *6	R_G = 10Ω	-	70	140	ns

●Gate Charge characteristics(Ta = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Total gate charge	Q_g *6	V_{DD} ≃ 250V	-	64	-	nC
Gate - Source charge	Q_{gs} *6	I_D = 21A	-	11	-	nC
Gate - Drain charge	Q_{gd} *6	V_{GS} = 10V	-	27	-	nC
Gate plateau voltage	$V_{(plateau)}$	V_{DD} ≃ 250V, I_D = 21A	-	5.8	-	V

*1 Limited only by maximum temperature allowed.

*2 PW ≤ 10µs, Duty cycle ≤ 1%

*3 L ≃ 500µH, V_{DD} = 50V, R_G = 25Ω, starting T_j = 25°C

*4 L ≃ 500µH, V_{DD} = 50V, R_G = 25Ω, starting T_j = 25°C, f = 10kHz

*5 Reference measurement circuits Fig.5-1.

*6 Pulsed

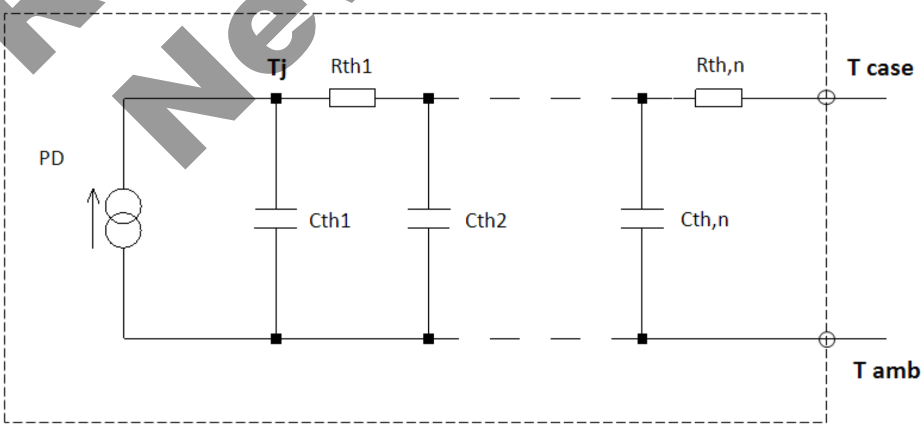
●Body diode electrical characteristics (Source-Drain)(Ta = 25°C)

Parameter	Symbol	Conditions	Values			Unit
			Min.	Typ.	Max.	
Inverse diode continuous, forward current	I_S *1	T_c = 25°C	-	-	21	A
Inverse diode direct current, pulsed	I_{SM} *2		-	-	84	A
Forward voltage	V_{SD} *6	V_{GS} = 0V, I_S = 21A	-	-	1.5	V
Reverse recovery time	t_{rr} *6	I_S = 21A di/dt = 100A/us	-	477	-	ns
Reverse recovery charge	Q_{rr} *6		-	7.8	-	μC
Peak reverse recovery current	I_{rrm} *6		-	32.7	-	A
Peak rate of fall of reverse recovery current	di_{rr}/dt	T_j = 25°C	-	910	-	A/μs

●Typical Transient Thermal Characteristics

Symbol	Value	Unit
R_{th1}	0.0919	K/W
R_{th2}	0.607	
R_{th3}	2.14	

Symbol	Value	Unit
C_{th1}	0.00395	Ws/K
C_{th2}	0.0549	
C_{th3}	0.53	



●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

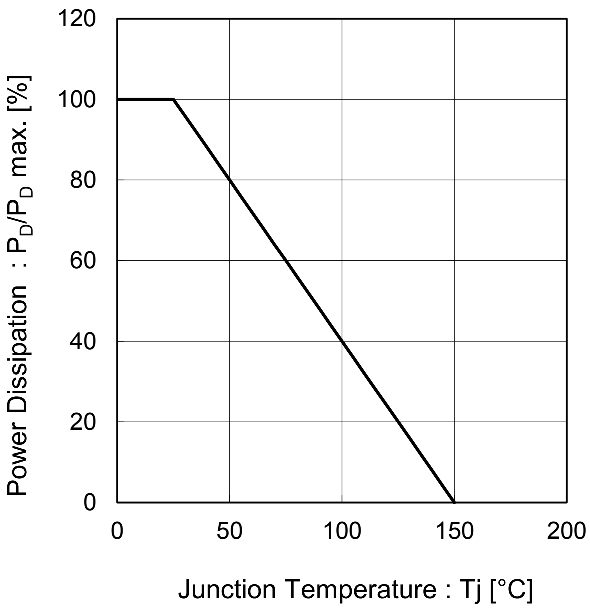


Fig.2 Maximum Safe Operating Area

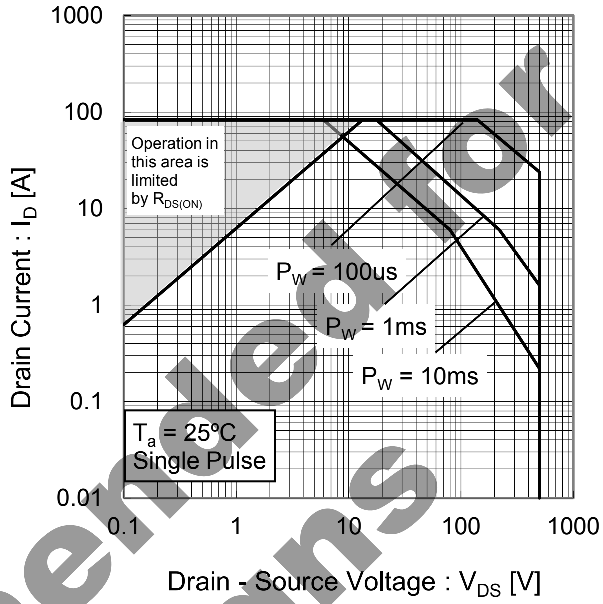
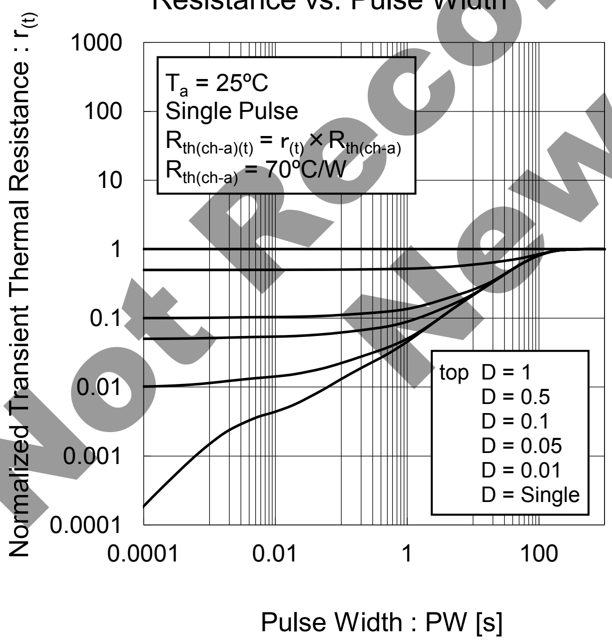


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Avalanche Current vs Inductive Load

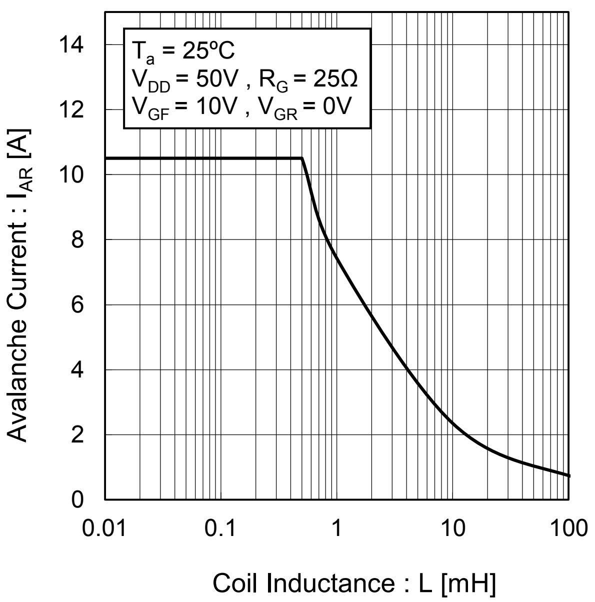


Fig.5 Avalanche Power Losses

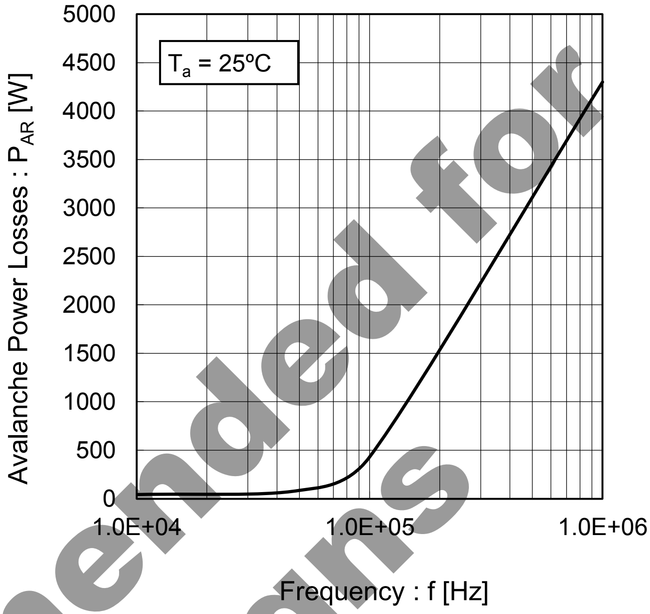
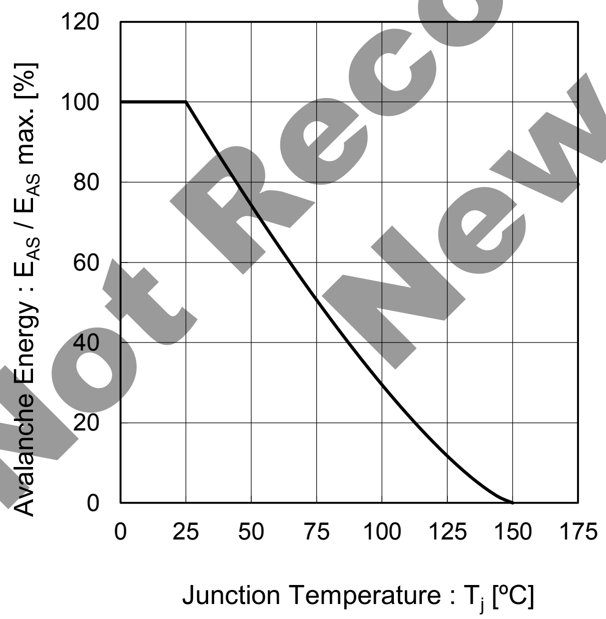


Fig.6 Avalanche Energy Derating Curve vs Junction Temperature



●Electrical characteristic curves

Fig.7 Typical Output Characteristics(I)

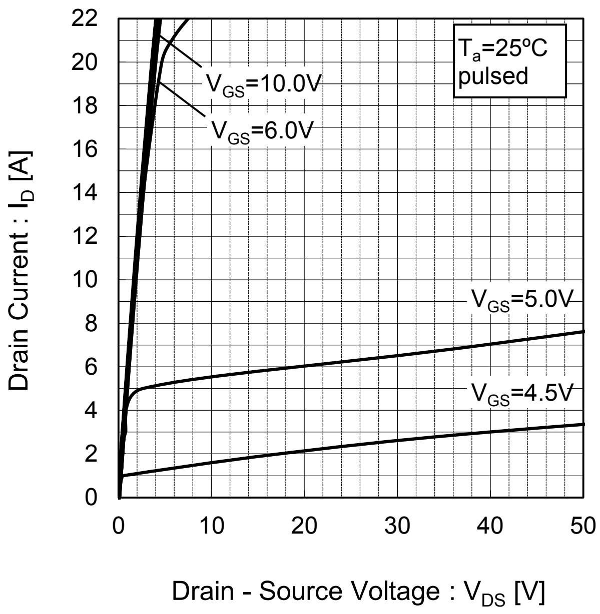


Fig.8 Typical Output Characteristics(II)

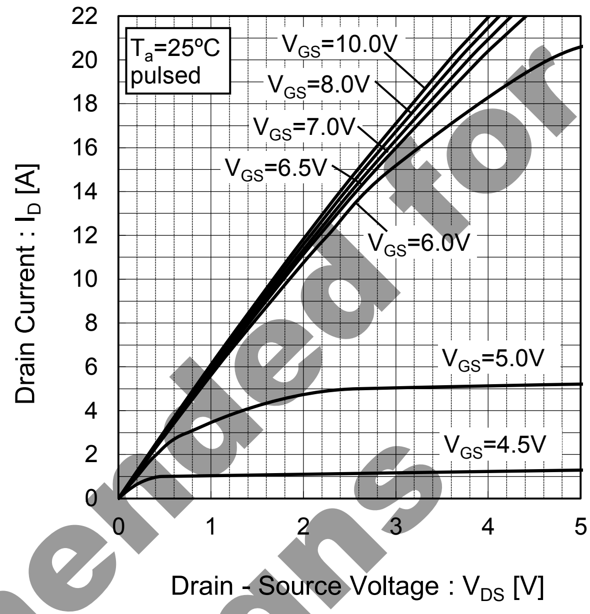


Fig.9 T$_j$ = 150°C Typical Output Characteristics(I)

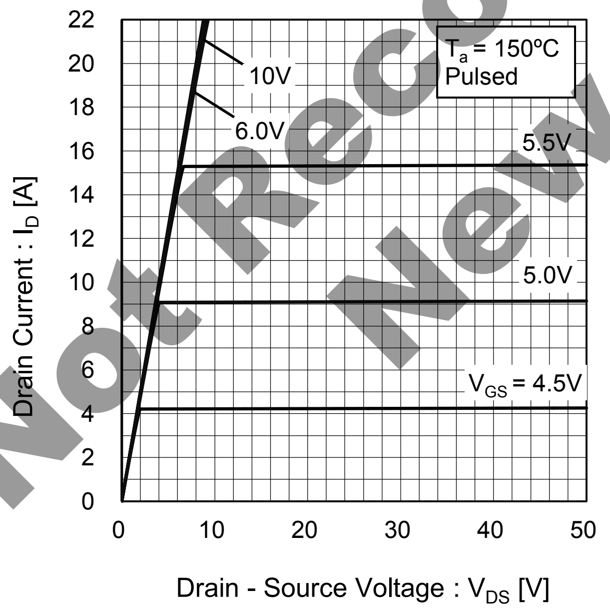
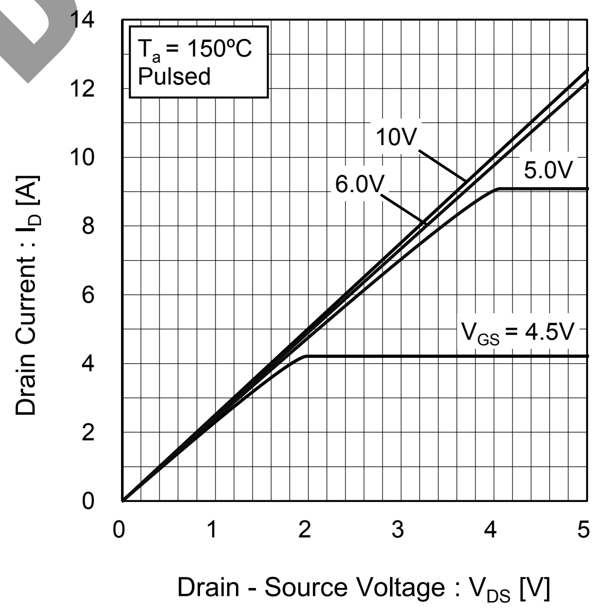


Fig.10 T$_j$ = 150°C Typical Output Characteristics(II)



●Electrical characteristic curves

Fig.11 Breakdown Voltage vs. Junction Temperature

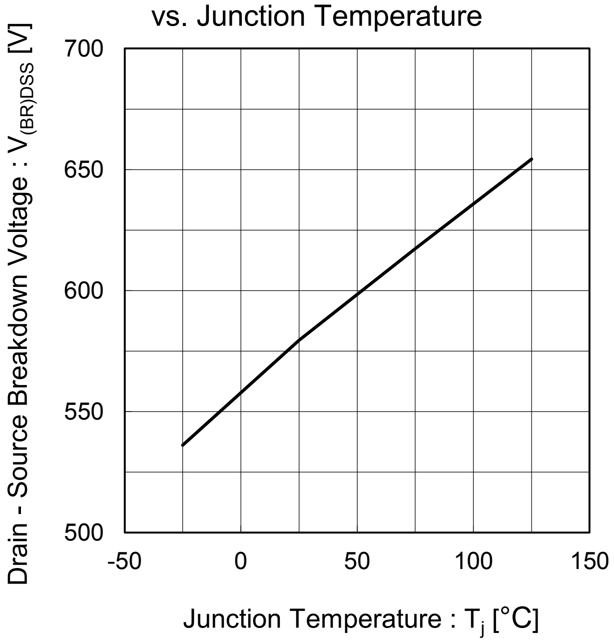


Fig.12 Typical Transfer Characteristics

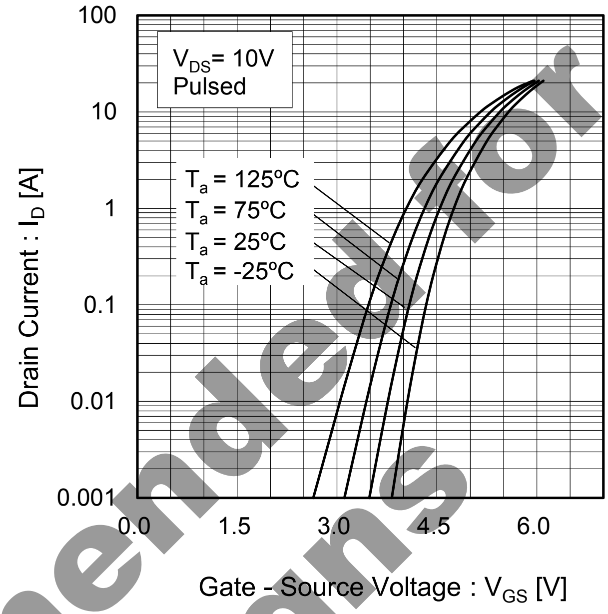


Fig.13 Gate Threshold Voltage vs. Junction Temperature

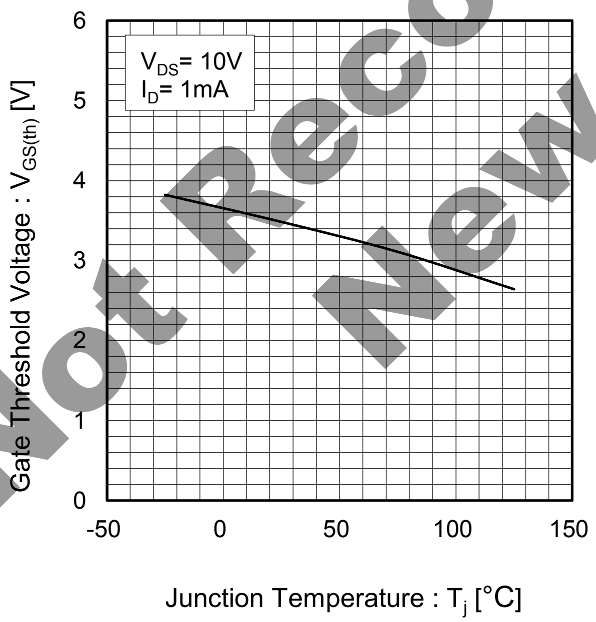
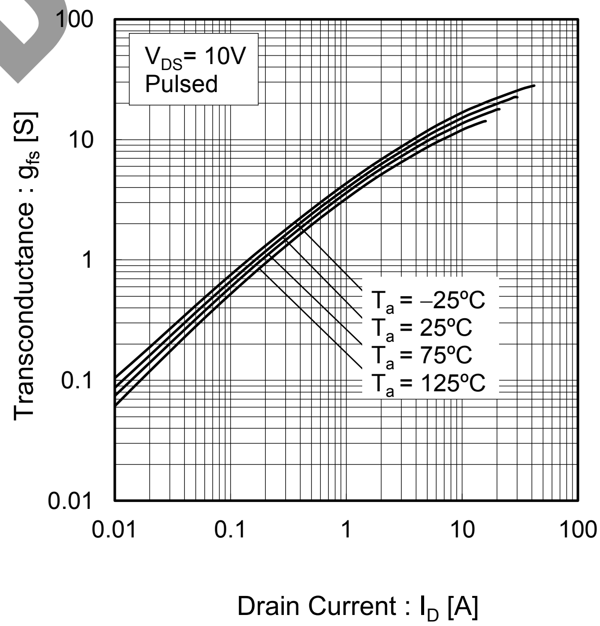


Fig.14 Transconductance vs. Drain Current



●Electrical characteristic curves

Fig.15 Static Drain - Source On - State Resistance vs. Gate Source Voltage

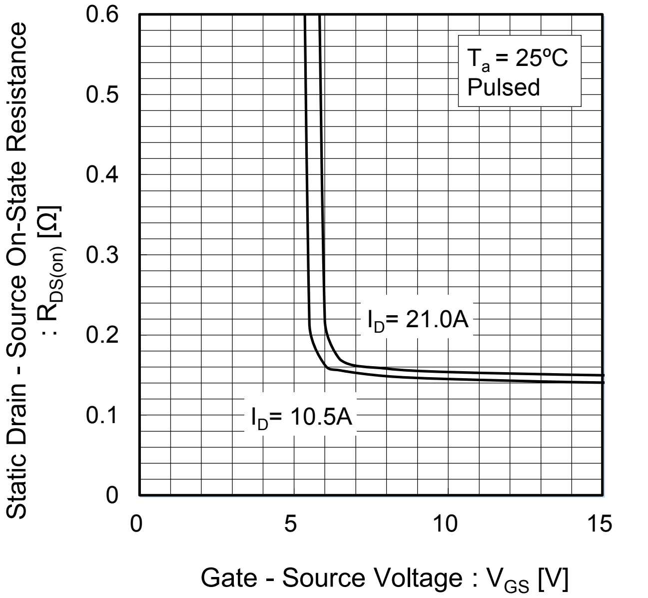


Fig.16 Static Drain - Source On - State Resistance vs. Junction Temperature

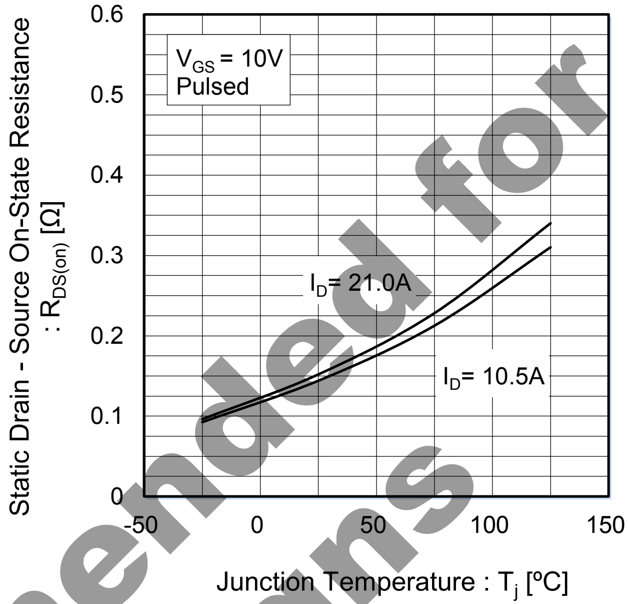
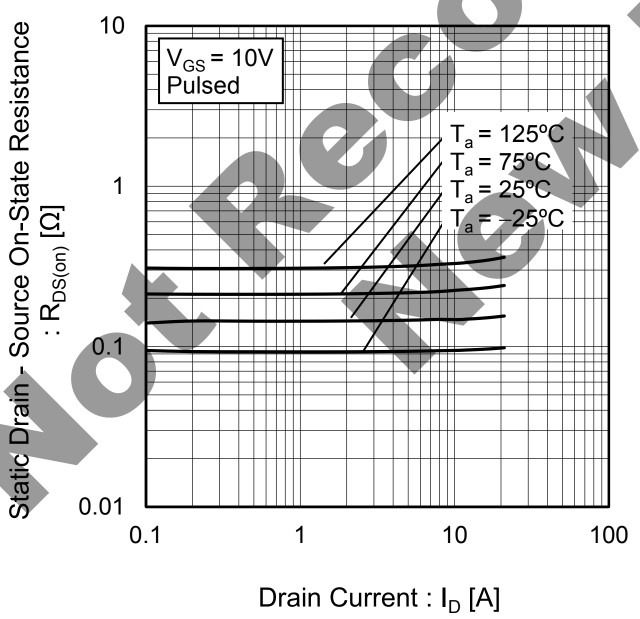


Fig.17 Static Drain - Source On - State Resistance vs. Drain Current



●Electrical characteristic curves

Fig.18 Typical Capacitance vs. Drain - Source Voltage

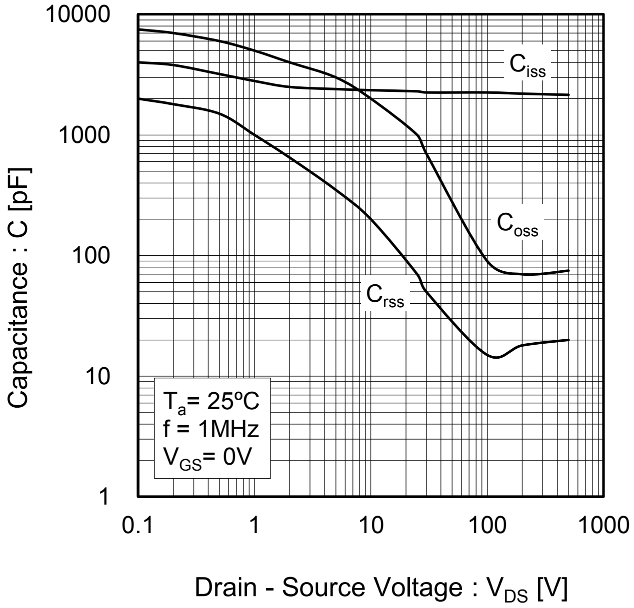


Fig.19 Coss Stored Energy

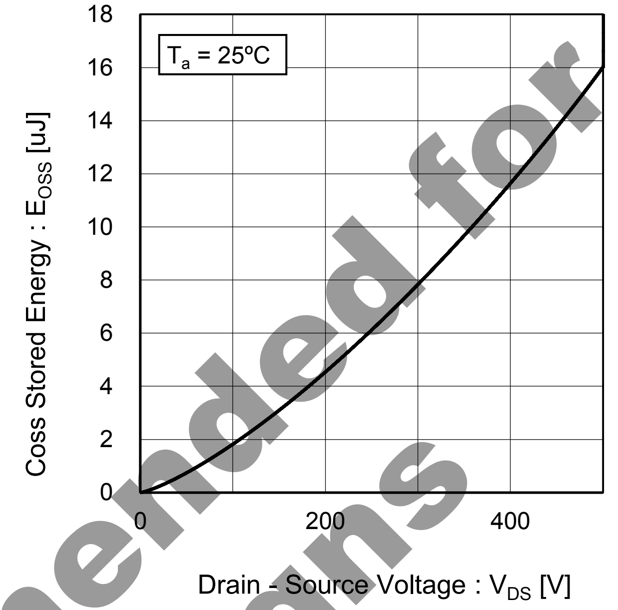


Fig.20 Switching Characteristics

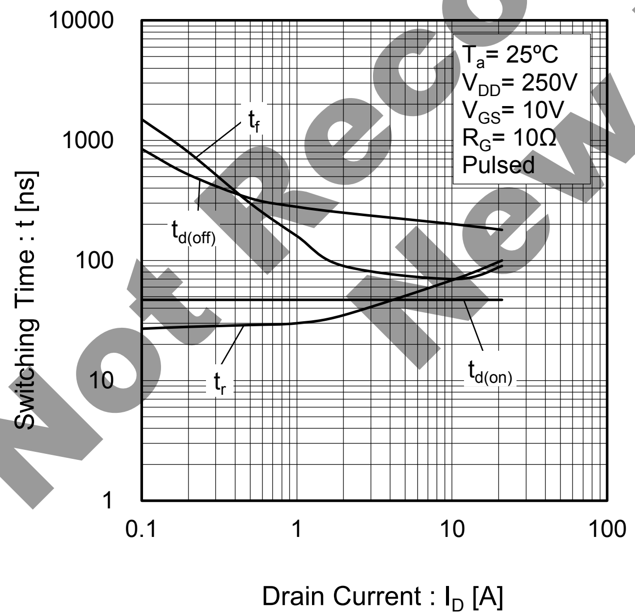
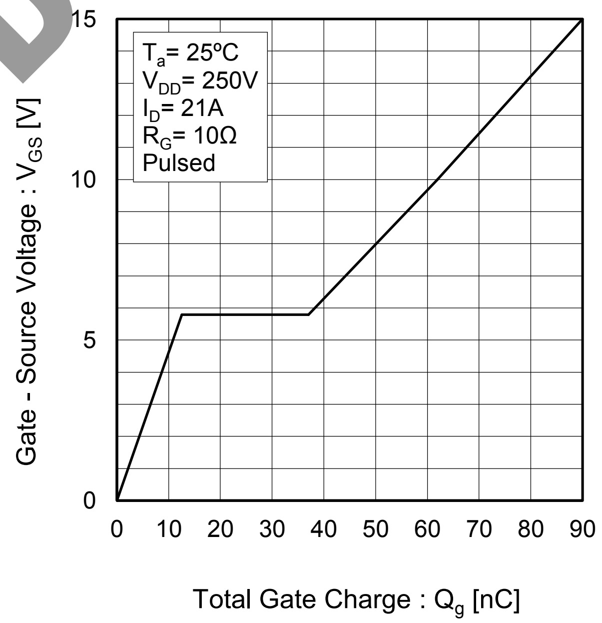
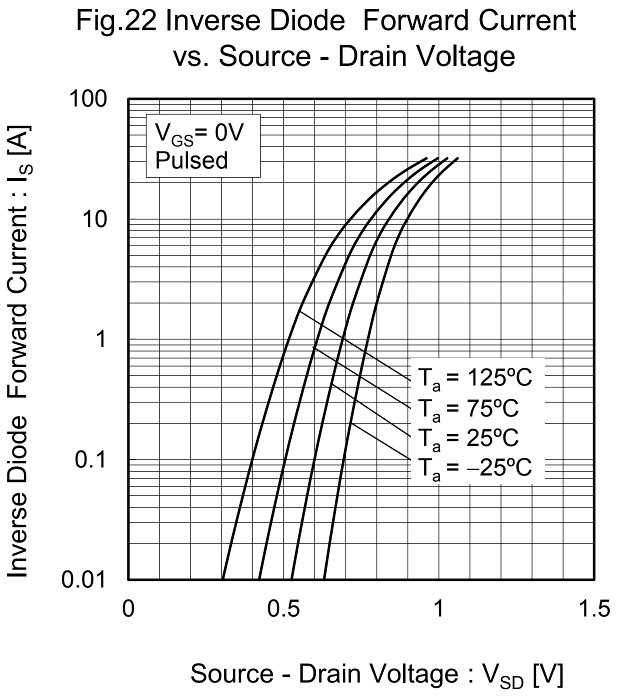
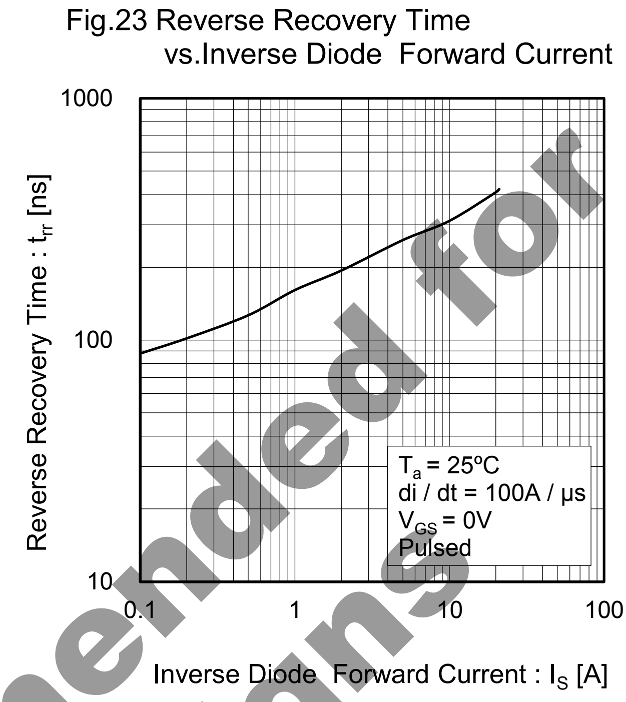


Fig.21 Dynamic Input Characteristics



● **Electrical characteristic curves**





●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

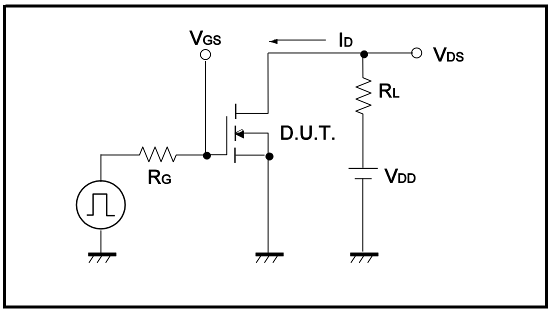


Fig.1-2 Switching Waveforms

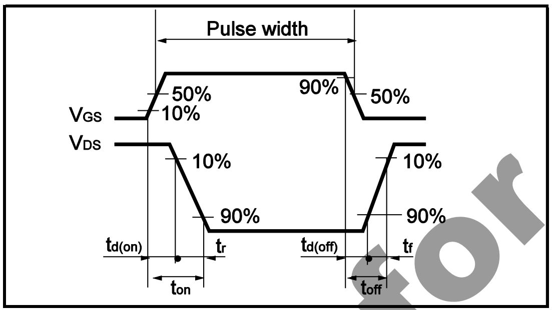


Fig.2-1 Gate Charge Measurement Circuit

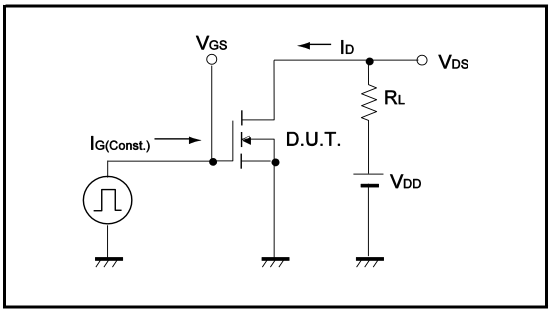


Fig.2-2 Gate Charge Waveform

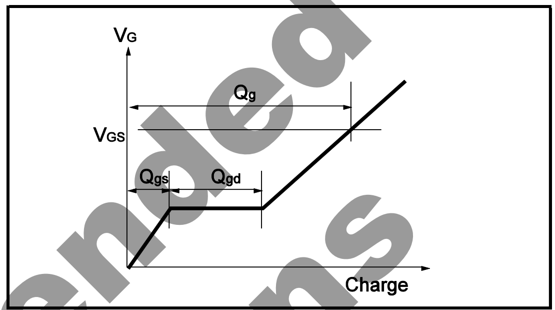


Fig.3-1 Avalanche Measurement Circuit

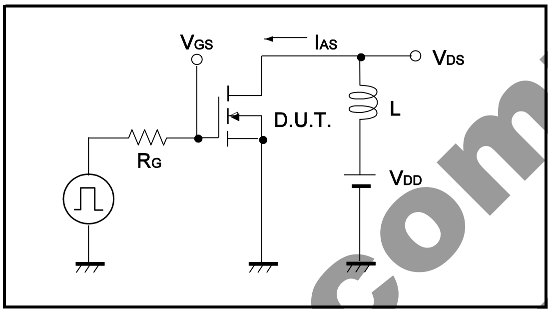


Fig.3-2 Avalanche Waveform

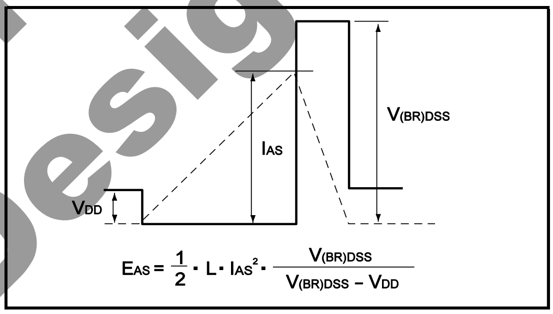


Fig.4-1 dv/dt Measurement Circuit

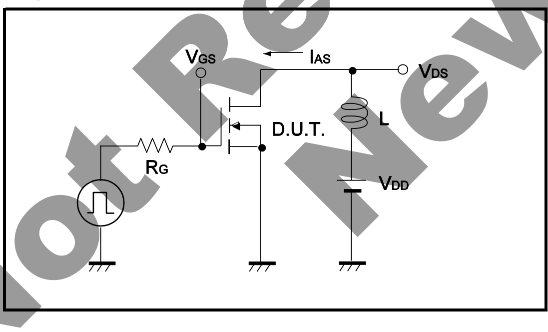


Fig.4-2 dv/dt Waveform

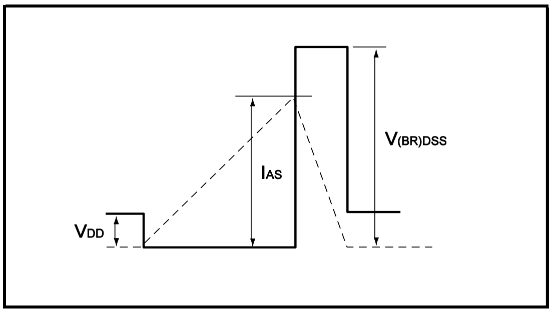


Fig.5-1 di/dt Measurement Circuit

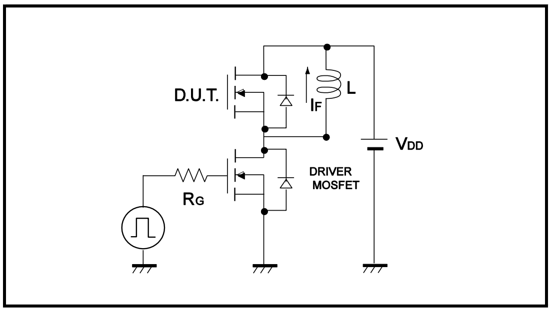
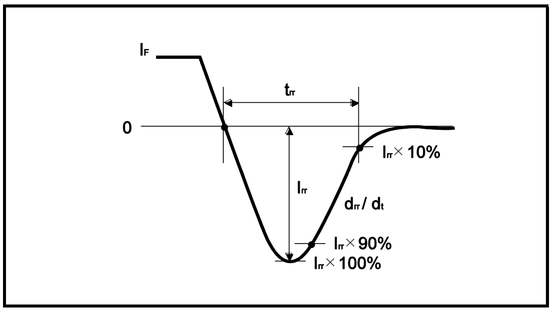
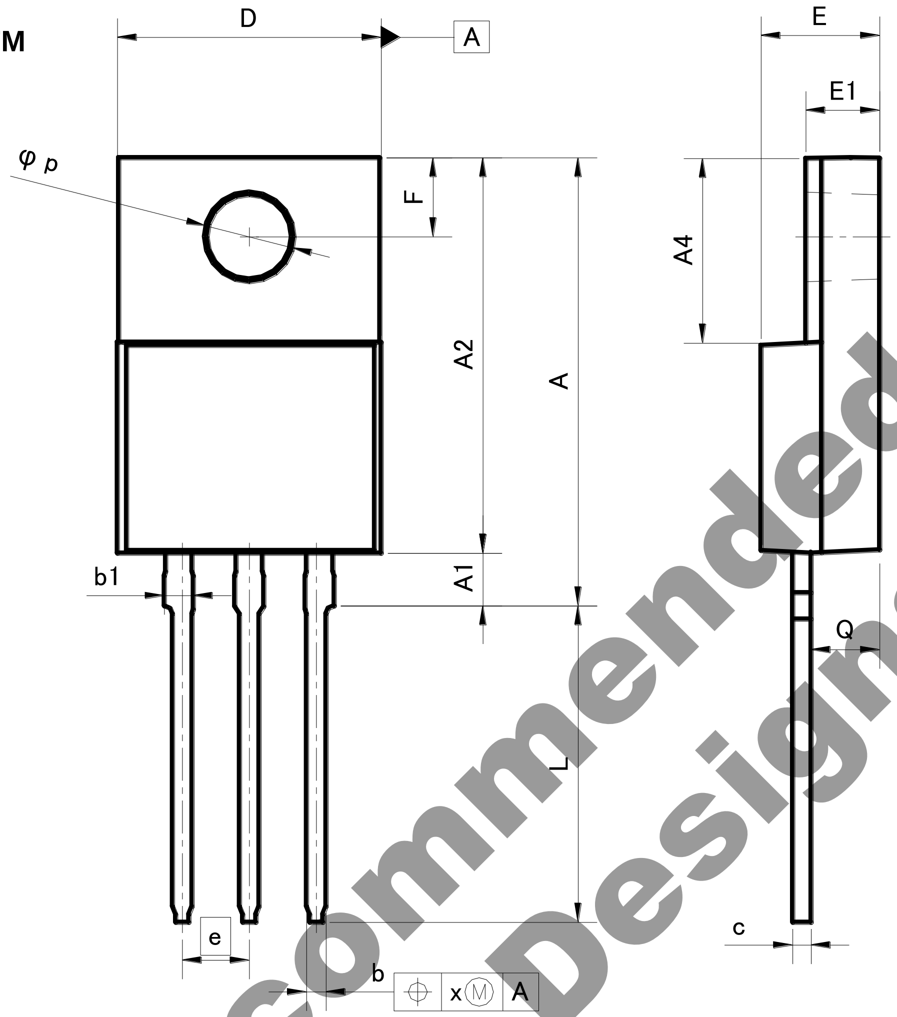


Fig.5-2 di/dt Waveform



●Dimensions (Unit : mm)

TO-220FM



DIM	MILIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	16.60	17.60	0.654	0.693
A1	1.80	2.20	0.071	0.087
A2	14.80	15.40	0.583	0.606
A4	6.80	7.20	0.268	0.283
b	0.70	0.85	0.028	0.033
b1	1.10	1.50	0.043	0.059
c	0.70	0.85	0.028	0.033
D	9.90	10.30	0.39	0.406
E	4.40	4.80	0.173	0.189
e	2.54		0.10	
E1	2.70	3.00	0.106	0.118
F	2.80	3.20	0.11	0.126
L	11.50	12.50	0.453	0.492
p	3.00	3.40	0.118	0.134
Q	2.10	3.10	0.083	0.122
x	–	0.381	–	0.015

Dimension in mm/inches

Notes

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