

N-Channel Power MOSFET 12A, 650Volts

DESCRIPTION

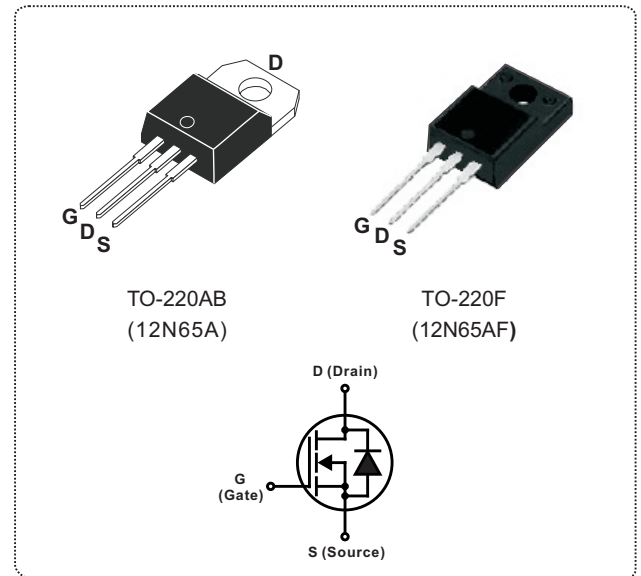
The Nell **12N65** is a three-terminal silicon device with current conduction capability of 12A, fast switching speed, low on-state resistance, breakdown voltage rating of 650V, and max. threshold voltage of 4 volts.

They are designed for use in applications such as switched mode power supplies, DC to DC converters, **PWM** motor controls, bridge circuits and general purpose switching applications.

To minimize on-state resistance, provide superior switching performance and commutation mode.

FEATURES

- $R_{DS(ON)} = 0.85\Omega$ @ $V_{GS} = 10V$
- Ultra low gate charge(54nC max.)
- Low reverse transfer capacitance ($C_{RSS} = 25pF$ typical)
- Fast switching capability
- 100% avalanche energy specified
- Improved dv/dt capability
- 150°C operation temperature



PRODUCT SUMMARY

I_D (A)	12
V_{DSS} (V)	650
$R_{DS(ON)}$ (Ω)	0.85 @ $V_{GS} = 10V$
Q_G (nC) max.	54

ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ C$ unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	VALUE	UNIT
V_{DSS}	Drain to Source voltage	$T_J = 25^\circ C$ to $150^\circ C$	650	V
V_{DGR}	Drain to Gate voltage	$R_{GS} = 20K\Omega$	650	
V_{GS}	Gate to Source voltage		± 30	
I_D	Continuous Drain Current	$T_C = 25^\circ C$	12	A
		$T_C = 100^\circ C$	7.4	
I_{DM}	Pulsed Drain current(Note 1)		48	
I_{AR}	Avalanche current(Note 1)		12	mJ
E_{AR}	Repetitive avalanche energy(Note 1)	$I_{AR} = 12A, R_{GS} = 50\Omega, V_{GS} = 10V$	24	
E_{AS}	Single pulse avalanche energy(Note 2)	$I_{AS} = 12A, L = 10mH$	790	
dv/dt	Peak diode recovery dv/dt(Note 3)		4.5	V/ns
P_D	Total power dissipation	$T_C = 25^\circ C$	TO-220AB 225	W
			TO-220F 51	
T_J	Operation junction temperature		-55 to 150	$^\circ C$
T_{STG}	Storage temperature		-55 to 150	
T_L	Maximum soldering temperature, for 10 seconds	1.6mm from case	300	
	Mounting torque, #6-32 or M3 screw		10 (1.1)	lbf-in (N·m)

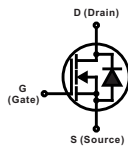
Note: 1. Repetitive rating: pulse width limited by junction temperature.

2. $I_{AS} = 12A, L = 10mH, V_{DD} = 50V, R_{GS} = 25\Omega$, starting $T_J = 25^\circ C$.

3. $I_{SD} \leq 12A, di/dt \leq 200A/\mu s, V_{DD} \leq V_{(BR)DSS}$, starting $T_J = 25^\circ C$.

THERMAL RESISTANCE						
SYMBOL	PARAMETER		Min.	Typ.	Max.	UNIT
$R_{th(j-c)}$	Thermal resistance, junction to case	TO-220AB			0.56	°C/W
		TO-220F			2.4	
$R_{th(j-a)}$	Thermal resistance, junction to ambient	TO-220AB			62.5	°C/W
		TO-220F			62.5	

ELECTRICAL CHARACTERISTICS (T _C = 25°C unless otherwise specified)							
SYMBOL	PARAMETER	TEST CONDITIONS		Min.	Typ.	Max.	UNIT
◎ OFF CHARACTERISTICS							
V _{(BR)DSS}	Drain to source breakdown voltage	I _D = 250μA, V _{GS} = 0V		650			V
ΔV _{(BR)DSS} /ΔT _J	Breakdown voltage temperature coefficient	I _D = 250μA, V _{DS} = V _{GS}			0.7		V/°C
I _{DSS}	Drain to source leakage current	V _{DS} =650V, V _{GS} =0V	T _C = 25°C			10	μA
		V _{DS} =520V, V _{GS} =0V	T _C =125°C			100	
I _{GSS}	Gate to source forward leakage current	V _{GS} = 30V, V _{DS} = 0V				100	nA
	Gate to source reverse leakage current	V _{GS} = -30V, V _{DS} = 0V				-100	
◎ ON CHARACTERISTICS							
R _{DS(ON)}	Static drain to source on-state resistance	V _{GS} = 10V, I _D = 6A			0.65	0.85	Ω
V _{GS(TH)}	Gate threshold voltage	V _{GS} =V _{DS} , I _D =250μA		2		4	V
◎ DYNAMIC CHARACTERISTICS							
C _{ISS}	Input capacitance	V _{DS} = 25V, V _{GS} = 0V, f = 1MHz			1480	1900	pF
C _{OSS}	Output capacitance				200	270	
C _{RSS}	Reverse transfer capacitance				25	35	
R _G	Gate resistance	V _{DS} = 0V, V _{GS} = 0V, f = 1MHz		0.2		1.2	Ω
◎ SWITCHING CHARACTERISTICS							
t _{d(ON)}	Turn-on delay time	V _{DD} = 325V, V _{GS} = 10V I _D = 12A, R _{GS} = 25Ω (Note 1,2)			30	70	ns
t _r	Rise time				115	240	
t _{d(OFF)}	Turn-off delay time				95	200	
t _f	Fall time				85	180	
Q _G	Total gate charge	V _{DD} = 520V, V _{GS} = 10V I _D = 12A, (Note 1,2)			42	54	nC
Q _{GS}	Gate to source charge				8.6		
Q _{GD}	Gate to drain charge (Miller charge)				21		

SOURCE TO DRAIN DIODE RATINGS AND CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise specified)						
SYMBOL	PARAMETER	TEST CONDITIONS	Min.	Typ.	Max.	UNIT
V_{SD}	Diode forward voltage	$I_{SD} = 12\text{A}$, $V_{GS} = 0\text{V}$			1.4	V
$I_S(I_{SD})$	Continuous source to drain current	Integral reverse P-N junction diode in the MOSFET 			12	A
I_{SM}	Pulsed source current				48	
t_{rr}	Reverse recovery time	$I_{SD} = 12\text{A}$, $V_{GS} = 0\text{V}$, $di_F/dt = 100\text{A}/\mu\text{s}$		380		ns
Q_{rr}	Reverse recovery charge			3.5		μC

Note: 1. Pulse test: Pulse width $\leq 300\mu\text{s}$, duty cycle $\leq 2\%$.

2. Essentially independent of operating temperature.

ORDERING INFORMATION SCHEME

12 N 65 A

Current rating, I_D
 12 = 12A

MOSFET series
 N = N-Channel

Voltage rating, V_{DS}
 65 = 650V

Package type
 A = TO-220AB
 AF = TO-220F

■ TEST CIRCUITS AND WAVEFORMS

Fig.1A Peak diode recovery dv/dt test circuit

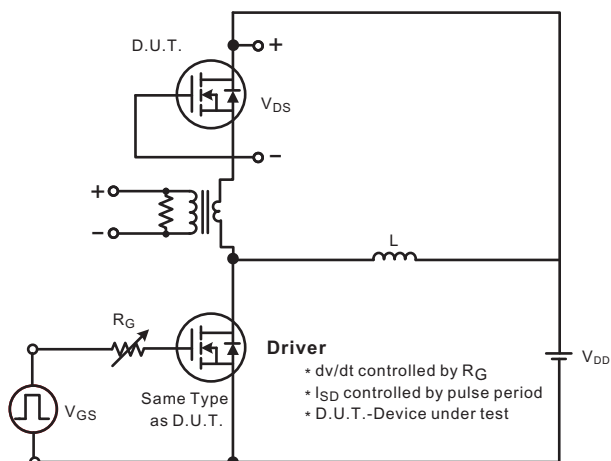
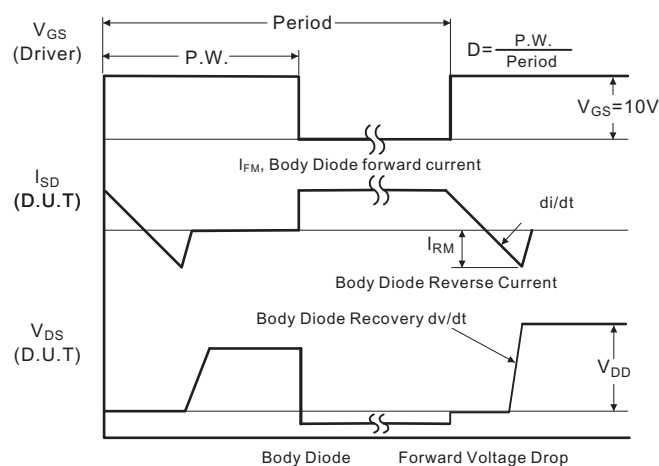


Fig.1B Peak diode recovery dv/dt waveforms



■ TEST CIRCUITS AND WAVEFORMS (Cont.)

Fig.2A Switching test circuit

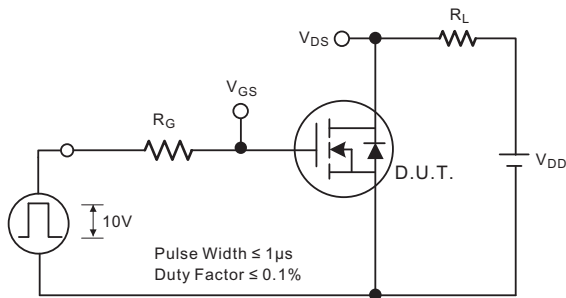


Fig.2B Switching Waveforms

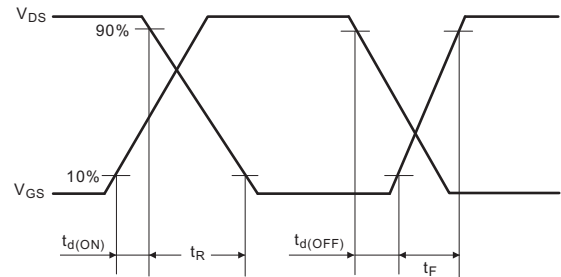


Fig.3A Gate charge test circuit

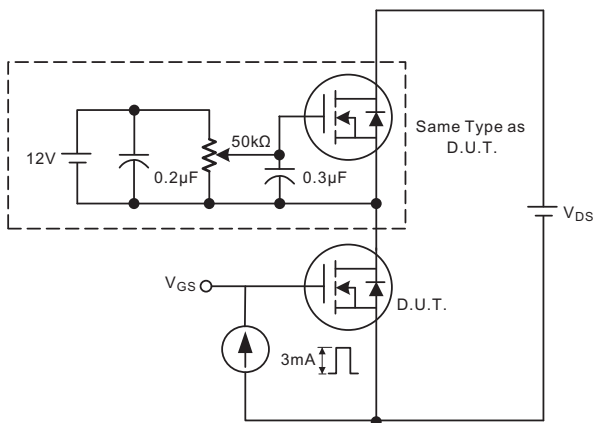


Fig.3B Gate charge waveform

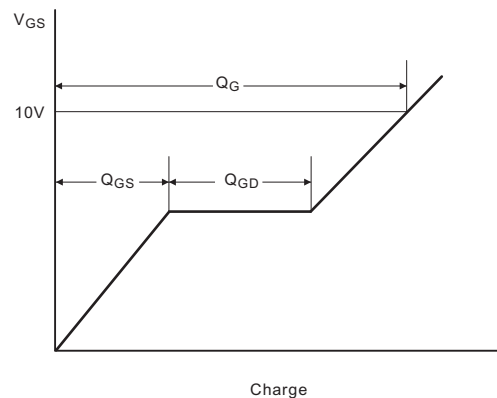


Fig.4A Unclamped Inductive switching test circuit

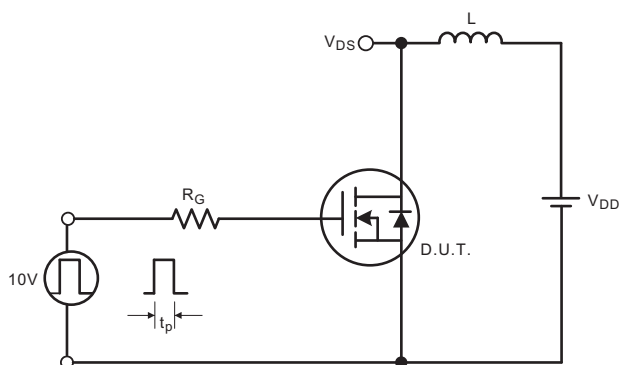
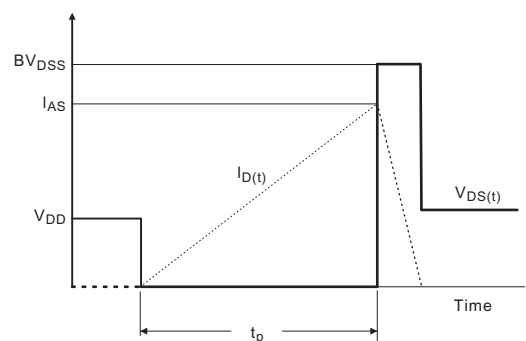


Fig.4B Unclamped Inductive switching waveforms



■ TYPICAL CHARACTERISTICS

Fig.1 On-State characteristics

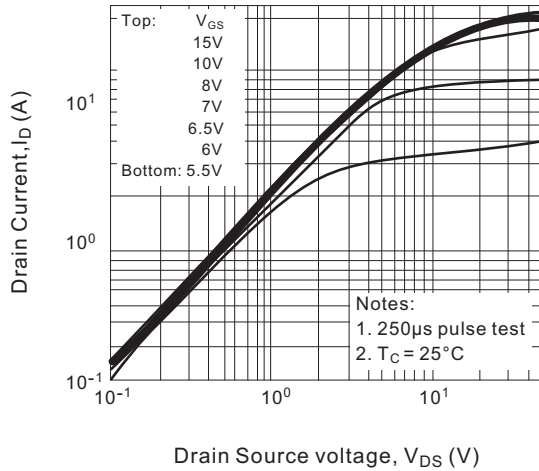


Fig.2 Transfer characteristics

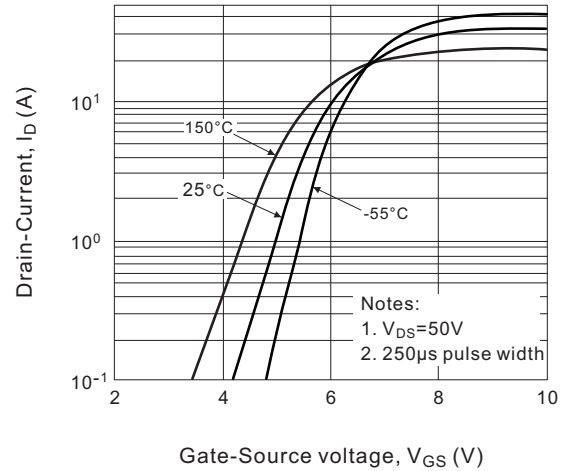


Fig.3 On-Resistance variation vs. Drain current and Gate voltage

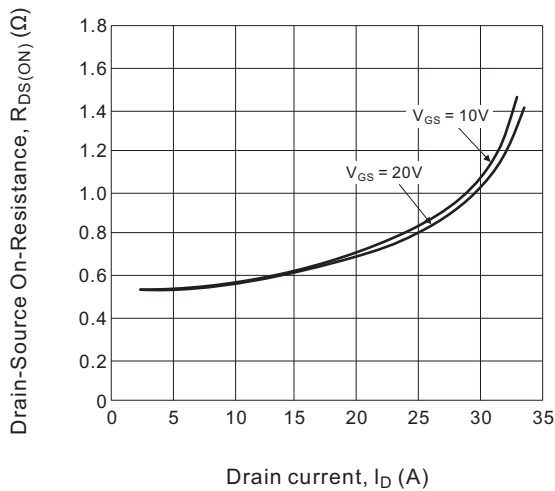


Fig.4 Body diode forward voltage variation vs Source current and Temperature

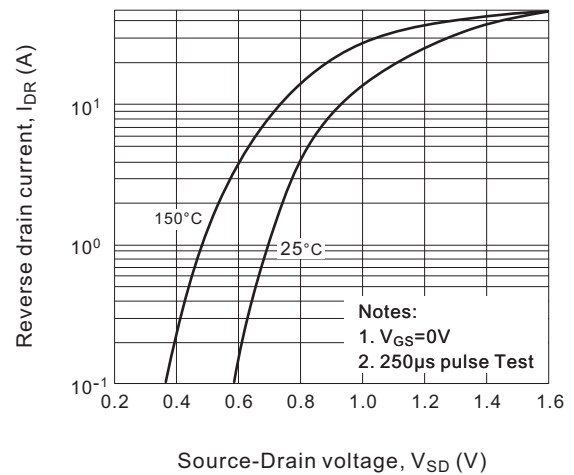


Fig.5 Capacitance characteristics

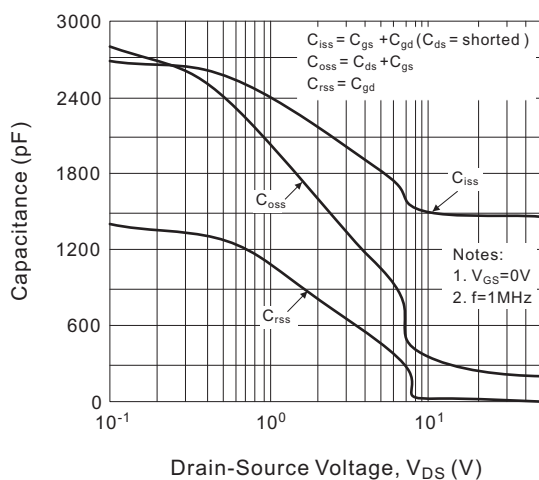


Fig.6 Gate charge characteristics

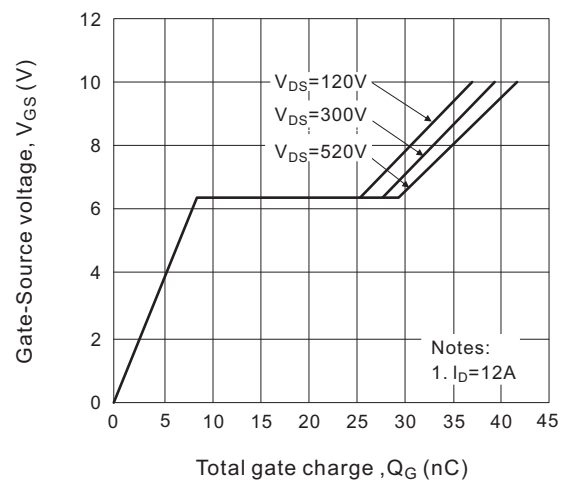
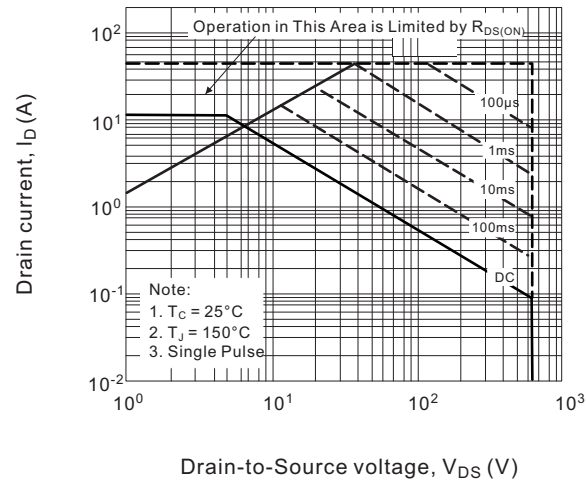
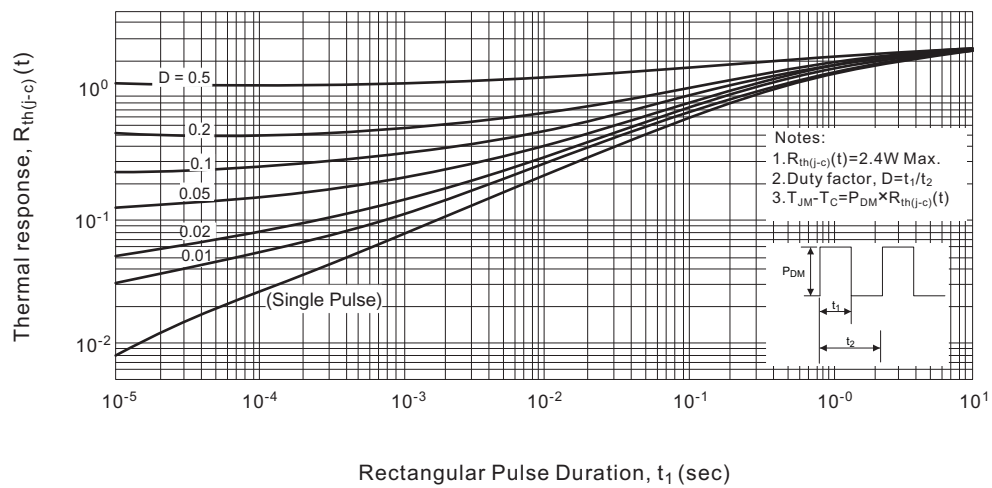
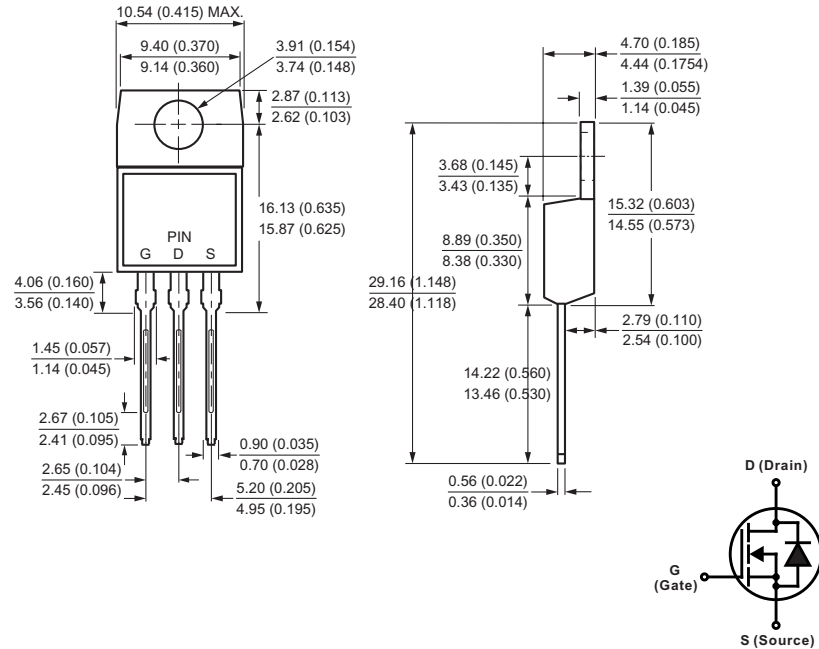


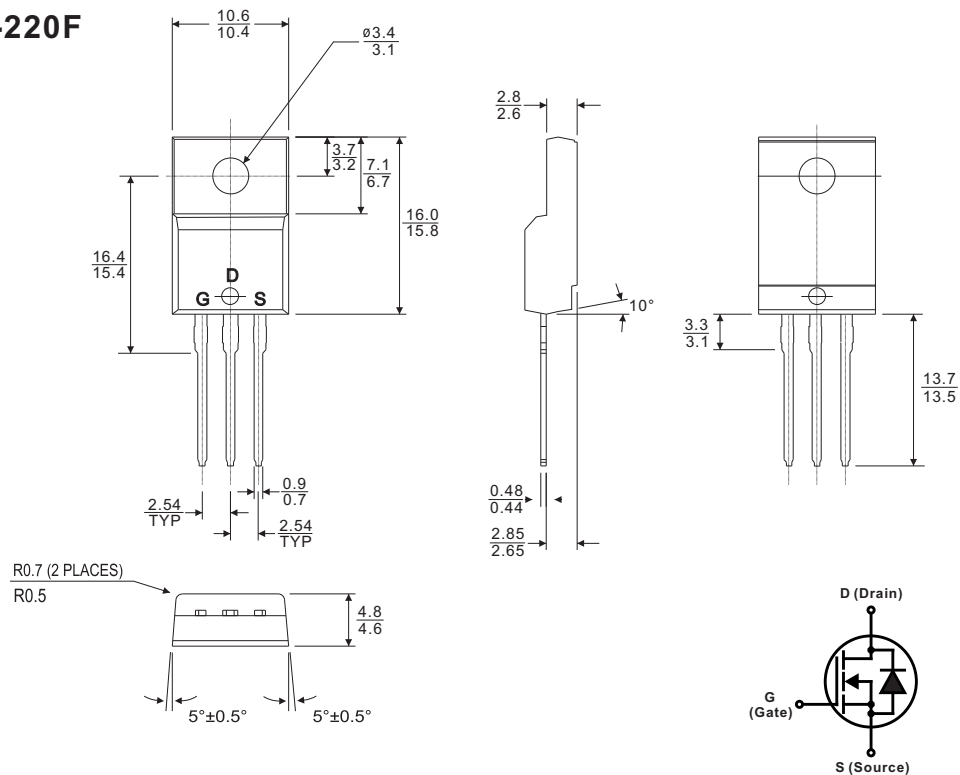
Fig.7 Maximum safe operating area

Fig.8 Transient thermal response curve


TO-220AB



All dimensions in millimeters(inches)

TO-220F



All dimensions in millimeters