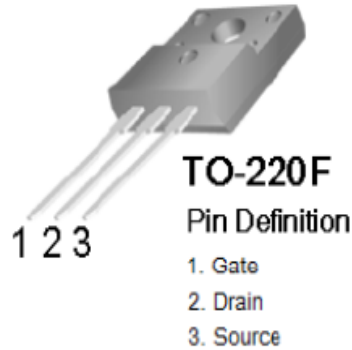


650V N-Channel Power MOSFET

Features

- High Voltage: $BV_{DSS}=650V(\text{Min.})$
- $I_D : 9A$
- Robust high voltage termination
- Avalanche energy specified
- Fast diode recovery time

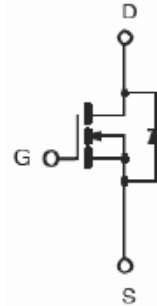


Application

- Ballast Bridge
- Switch Mode Power Supplier
- Power Factor Correction
- Lighting

Ordering Information

Type NO	Marking	Package Code
WMF9N65U	9N65FU	TO-220F



Absolute maximum ratings ($T_C=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Rating	Unit	
Drain-source voltage	V_{DSS}	650	V	
Gate-source voltage	V_{GSS}	± 30	V	
Drain current (DC) *	I_D	$T_C=25^\circ\text{C}$	9.0	A
		$T_C=100^\circ\text{C}$	5.7	A
Drain current (Pulsed) *	I_{DM}	36	A	
Single avalanche energy ②	E_{AS}	250	mJ	
Repetitive avalanche current ①	I_{AR}	9.0	A	
Repetitive avalanche energy ①	E_{AR}	3.2	mJ	
Power dissipation	P_D	32	W	
Junction temperature	T_J	150	$^\circ\text{C}$	
Storage temperature range	T_{stg}	-55~150	$^\circ\text{C}$	

* Limited by maximum junction temperature

Characteristic	Symbol	Typ.	Max	Unit	
Thermal resistance	Junction-case	$R_{th(J-C)}$	-	3.9	$^\circ\text{C}/\text{W}$
	Junction-ambient	$R_{th(J-A)}$	-	62.5	

Electrical Characteristics ($T_C=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	BV_{DSS}	$I_D=250\ \mu\text{A}, V_{GS}=0\text{V}$	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$I_D=250\ \mu\text{A}, V_{DS}=V_{GS}$	3.0	-	5.0	V
Drain-source cut-off current	I_{DSS}	$V_{DS}=650\text{V}, V_{GS}=0\text{V}$	-	-	1	μA
		$V_{DS}=650\text{V}, T_C=150^\circ\text{C}$			100	μA
Gate leakage current	I_{GSS}	$V_{DS}=0\text{V}, V_{GS}=\pm 30\text{V}$	-	-	± 100	nA
Drain-source on-resistance	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=4.5\text{A}$	-	0.7	0.9	Ω
Forward transfer conductance ③	g_{fs}	$V_{DS}=10\text{V}, I_D=4.5\text{A}$	-	11	-	S
Input capacitance	C_{iss}	$V_{DS}=25\text{V}, V_{GS}=0\text{V}$ $f=1\ \text{MHz}$	-	2150	-	pF
Output capacitance	C_{oss}		-	145	-	
Reverse transfer capacitance	C_{rss}		-	13	-	
Turn-on delay time ③④	$t_{d(on)}$	$V_{DS}=325\text{V}, I_D=9\text{A}$ $R_G=25\ \Omega$	-	94	-	ns
Rise time ③④	t_r		-	43	-	
Turn-off delay time ③④	$t_{d(off)}$		-	182	-	
Fall time ③④	t_f		-	28	-	
Total gate charge ③④	Q_g	$V_{DS}=520\text{V}, V_{GS}=10\text{V}$ $I_D=9\text{A}$	-	33	40	nC
Gate-source charge ③④	Q_{gs}		-	12.5	-	
Gate-drain charge ③④	Q_{gd}		-	8	-	

Source-Drain Diode Ratings and Characteristics ($T_C=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
Source current (DC)	I_S	Integral reverse diode in the MOSFET	-	-	9.0	A
Source current (Pulsed)	I_{SM}		-	-	36.0	
Forward voltage	V_{SD}	$V_{GS}=0\text{V}, I_{SD}=9\text{A}$	-	-	1.4	V
Reverse recovery time ③④	t_{rr}	$I_{SD}=9\text{A}, V_{GS}=0\text{V}$ $dI_F/dt=100\text{A}/\mu\text{s}$	-	490	-	ns
Reverse recovery charge ③④	Q_{rr}		-	2.7	-	μC

Note ;

1. Repetitive rating : Pulse width limited by safe operating area
2. $L=5.7\text{mH}, I_{AS}=9\text{A}, V_{DD}=50\text{V}, R_G=25\ \Omega, \text{Starting } T_J=25^\circ\text{C}$
3. Pulse Test : Pulse width $\leq 300\ \mu\text{s}$, Duty cycle $\leq 2\%$
4. Essentially independent of operating temperature typical characteristics

Electrical Characteristic Curves

Fig. 1 Typical Output Characteristics

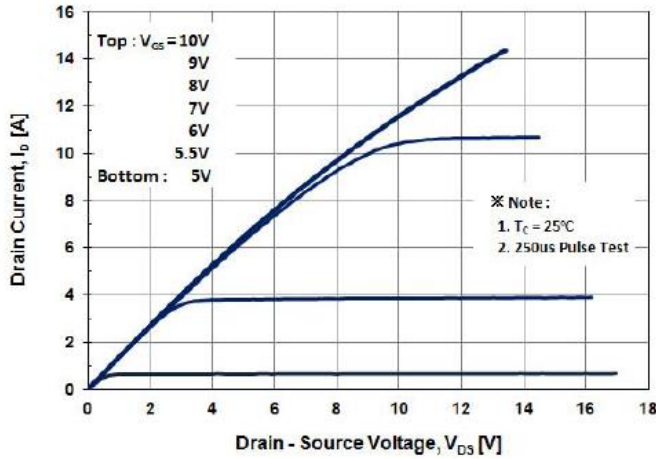


Fig. 2 Typical Transfer Characteristics

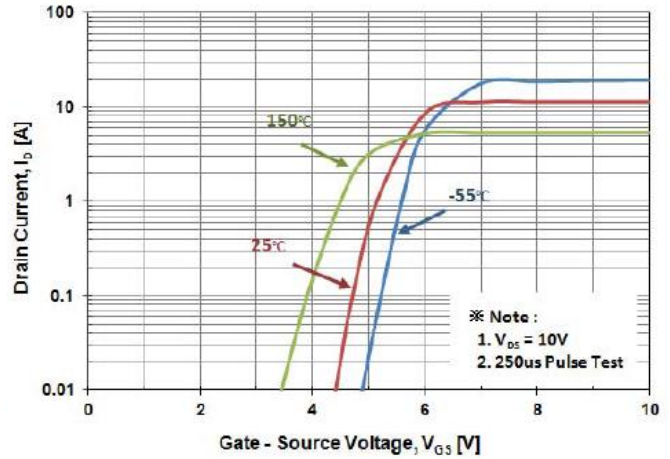


Fig. 5 Typical Capacitance Characteristics

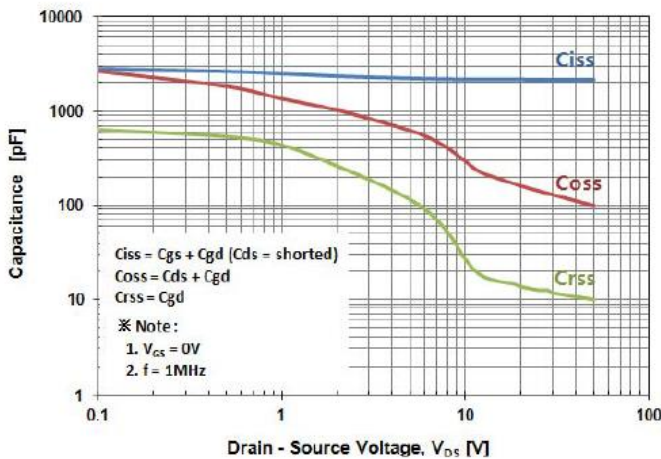


Fig. 6 Typical Total Gate Charge Characteristics

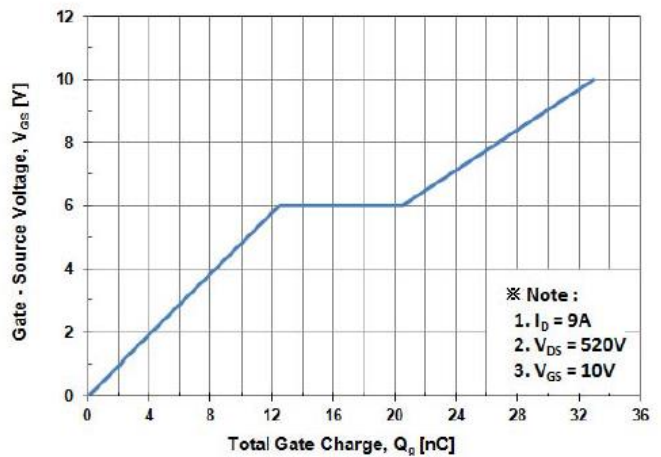


Fig.3 On-Resistance Variation with Drain Current and Gate Voltage

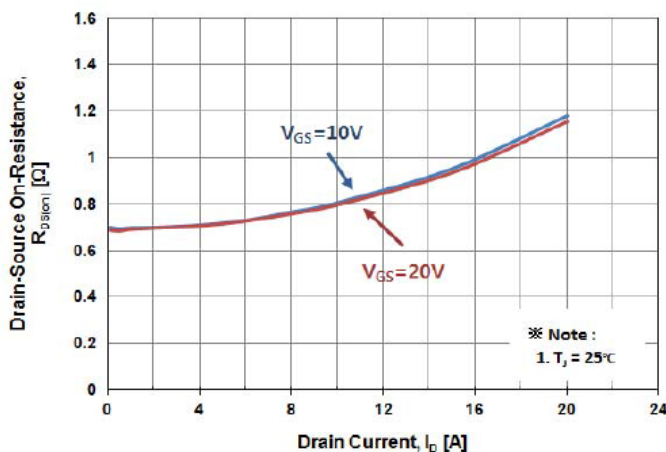
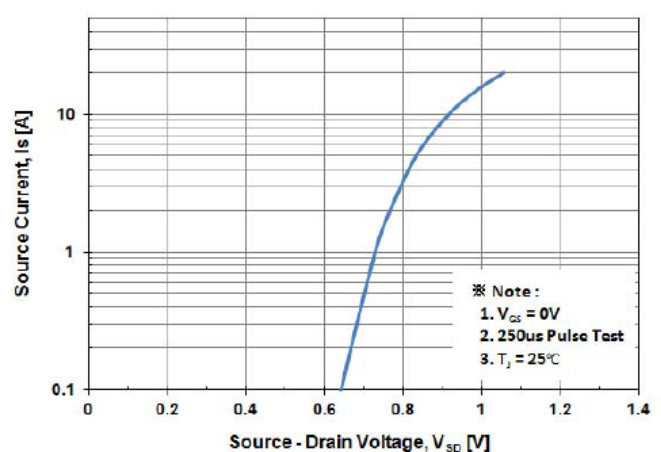


Fig. 4 Body Diode Forward Voltage Variation with Source Current



Electrical Characteristic Curves

Fig. 7 Breakdown Voltage Variation vs. Temperature

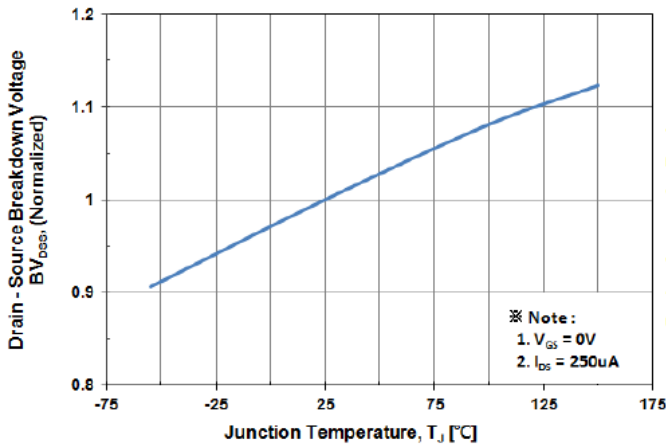


Fig. 8 On-Resistance Variation vs. Temperature

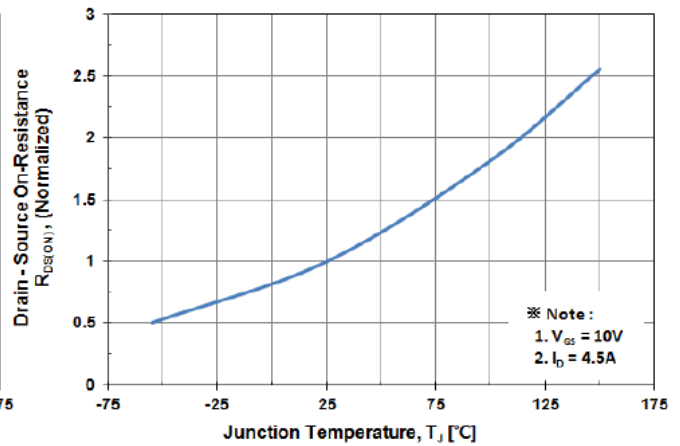


Fig. 9 Maximum Drain Current vs. Case Temperature

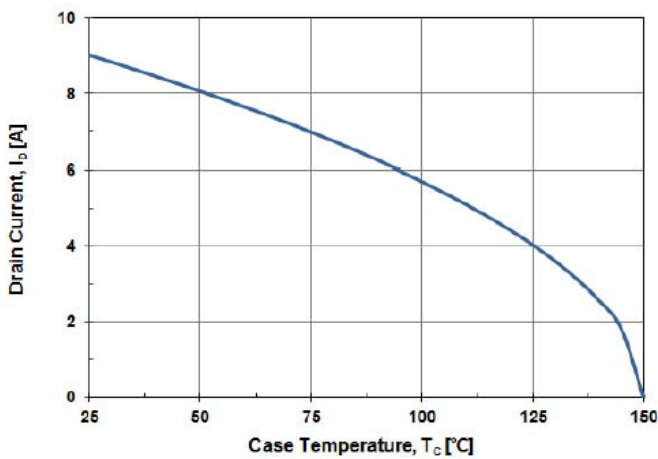


Fig. 10 Maximum Safe Operating Area

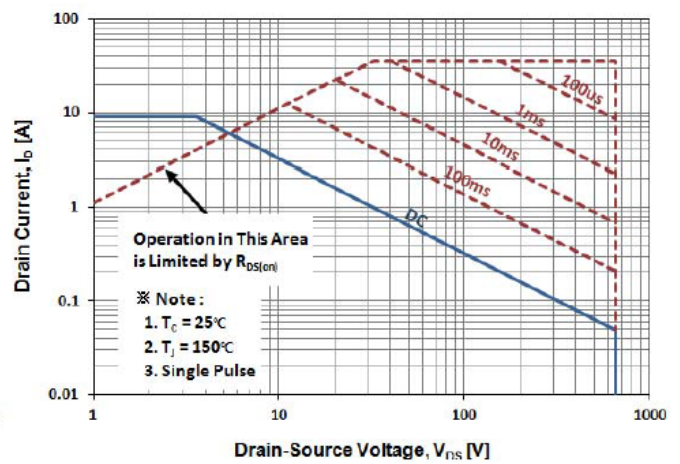
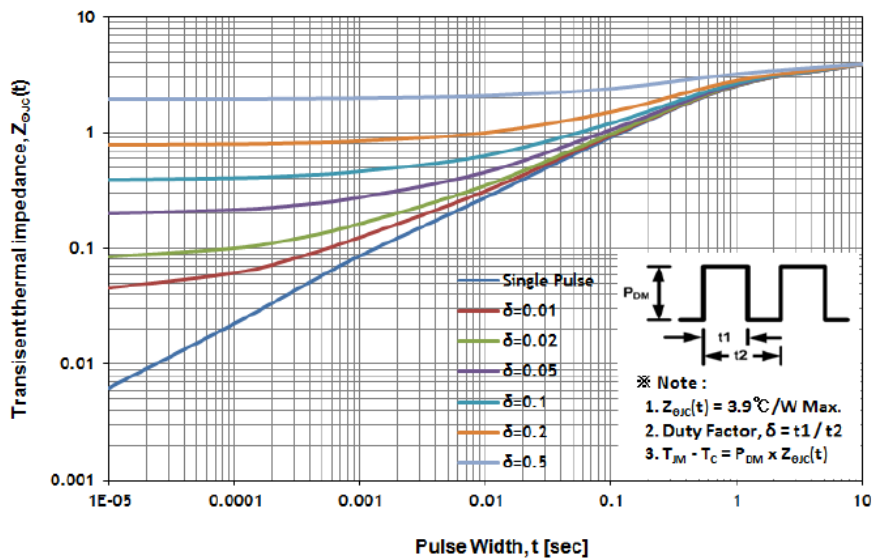
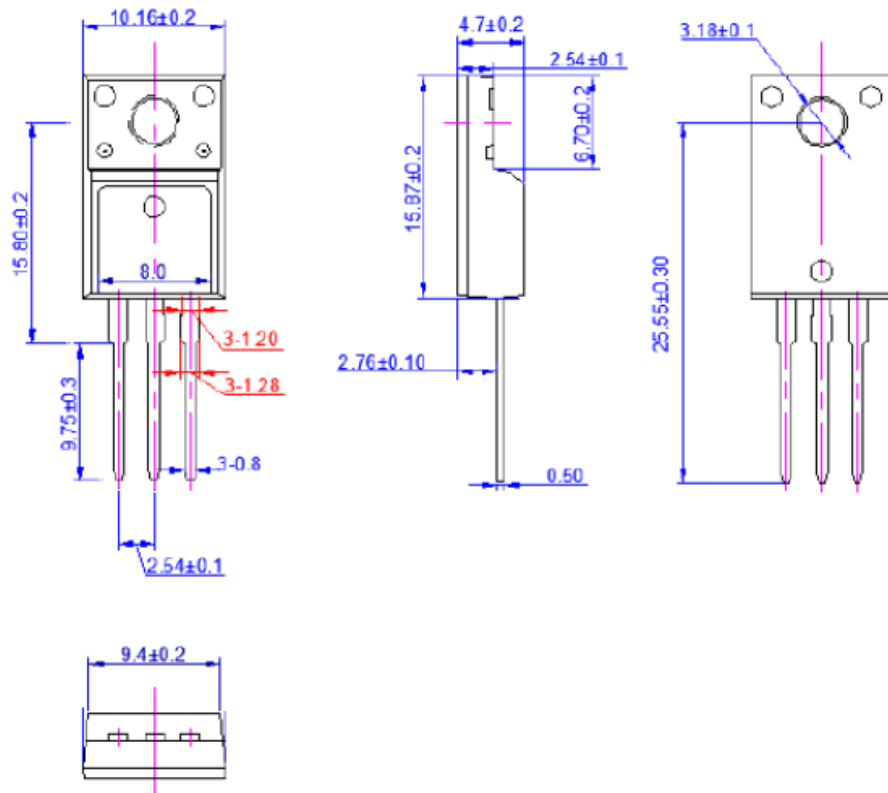


Fig. 11 Transient Thermal Impedance

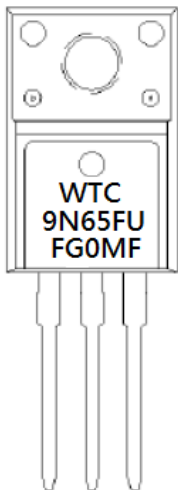


Outline Dimension : TO-220F



Unit : mm

Marking Diagram



First Line	WTC	Company Name	
Second Line	9N65FU	Product Code	
Third Line	FG0MF	1st (Year Code)	A-2010 B-2011 C-2012 ...
		2nd (Month Code)	A-Jan B-Feb C-Mar D-Apr E-May F-Jun G-Jul H-Aug I-Sep J-Oct K-Nov L-Dec
		3rd (Lot Code)	0-1 , A-9
		4th (Product Code)	M-MOS , T-Transistor
		5th (Package Code)	X-TO-220, F-TO-220F
		6th (Spec Code)	(Reserve)