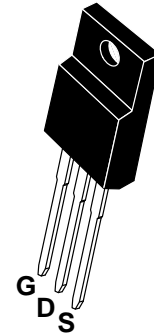


PIN Connection TO-220F



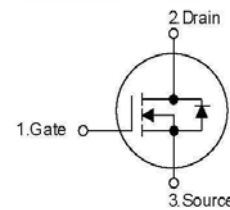
Description

The FIR4N90 N-Channel enhancement mode silicon gate power MOSFET is designed for high voltage, high speed power switching applications such as switching regulators, switching converters, solenoid, motor drivers, relay drivers

Features

- $R_{DS(ON)} = 3.1\Omega @ V_{GS} = 10V$
- Low gate charge (typical 24nC)
- High ruggedness
- Fast switching capability
- Avalanche energy specified
- Improved dv/dt capability

Inner Equivalent Principium Chart



Marking Diagram



- Y = Year
- A = Assembly Location
- WW = Work Week
- FIR4N90F = Specific Device Code

Absolute Maximum Ratings ($T_c=25^\circ\text{C}$, unless otherwise specified)

Parameter	Symbol	Ratings	Units
Drain-Source Voltage	V_{DSS}	900	V
Gate-Source Voltage	V_{GSS}	± 30	V
Drain Current Continuous	I_D	$T_c=25^\circ\text{C}$	2.5*
		$T_c=100^\circ\text{C}$	1.58
Drain Current Pulsed (Note 1)	I_{DP}	10*	A
Avalanche Energy	E_{AR}	Repetitive (Note 1)	4.7
		Single Pulse (Note 2)	570
Peak Diode Recovery dv/dt (Note 3)	dv/dt	4.0	V/ns
Total Power Dissipation	P_D	$T_c=25^\circ\text{C}$	47
		Derate above 25°C	0.38
Junction Temperature	T_J	+150	$^\circ\text{C}$
Storage Temperature	T_{STG}	-55~+150	$^\circ\text{C}$

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Parameter	Symbol	Ratings	Units
Thermal Resistance Junction-Ambient	R_{thJA}	62.5	°C/W
Thermal Resistance, Case-to-Sink Typ.	R_{thCS}	--	
Thermal Resistance Junction-Case	R_{thJC}	2.66	

Electrical Characteristics ($T_J=25^\circ\text{C}$, unless Otherwise specified.)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units	
Off Characteristics							
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0V, I_D=250\mu A$	900	--	--	V	
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS}=900V, V_{GS}=0V$	--	--	10	μA	
		$V_{DS}=720V, T_C=125^\circ\text{C}$	--	--	100	μA	
Gate-Body Leakage Current	Forward	I_{GSS}	$V_{GS}=30V, V_{DS}=0V$	--	--	100	nA
	Reverse					$V_{GS}=-30V, V_{DS}=0V$	--
Breakdown Voltage Temperature Coefficient	$\Delta BV_{DSS}/\Delta T_J$	$I_D=250\mu A$	--	0.90	--	V/°C	
On Characteristics							
Gate Threshold Voltage	$V_{GS(TH)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3.0	--	5.0	V	
Static Drain-Source On-Resistance	$R_{DS(ON)}$	$V_{DS}=10V, I_D=2.4A$	--	2.5	3.1	Ω	
Dynamic Characteristics							
Input Capacitance	C_{ISS}	$V_{DS}=25V, V_{GS}=0V, f=1\text{MHz}$	--	860	1100	pF	
Output Capacitance	C_{OSS}		--	90	120	pF	
Reverse Transfer Capacitance	C_{RSS}		--	9.5	12.5	pF	
Switching Characteristics							
Turn-On Delay Time	$t_{D(ON)}$	$V_{DD}=450V, I_D=4.2A, R_G=25\Omega$ (Note 4, 5)	--	25	60	ns	
Rise Time	t_R		--	70	150	ns	
Turn-Off Delay Time	$t_{D(OFF)}$		--	45	100	ns	
Fall Time	t_F		--	40	90	ns	
Total Gate Charge	Q_G	$V_{DS}=720V, I_D=4.2A, V_{GS}=10V$ (Note 4, 5)	--	24	30	nC	
Gate-Source Charge	Q_{GS}		--	5.8	--	nC	
Gate-Drain Charge	Q_{GD}		--	11.5	--	nC	
Drain-Source Diode Characteristics							
Drain-Source Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_{SD}=4.2A$	--	--	1.4	V	
Continuous Drain-Source Current	I_{SD}		--	--	4.2	A	
Pulsed Drain-Source Current	I_{SM}		--	--	16.8	A	
Reverse Recovery Time	t_{RR}	$V_{GS}=0V, I_{SD}=4.2A, di_{SD}/dt=100A/\mu s$ (Note 4)	--	440	--	ns	
Reverse Recovery Charge	Q_{RR}		--	3.3	--	μC	

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $L=61\text{ mH}, I_{AS}=4.2A, V_{DD}=50V, R_G=25\Omega$, Starting $T_J=25^\circ\text{C}$
3. $I_{SD}\leq 4.2A, di/dt\leq 200A/\mu s, V_{DD}\leq BV_{DSS}$, Starting $T_J=25^\circ\text{C}$
4. Pulse Test : Pulse width $\leq 300\mu s$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

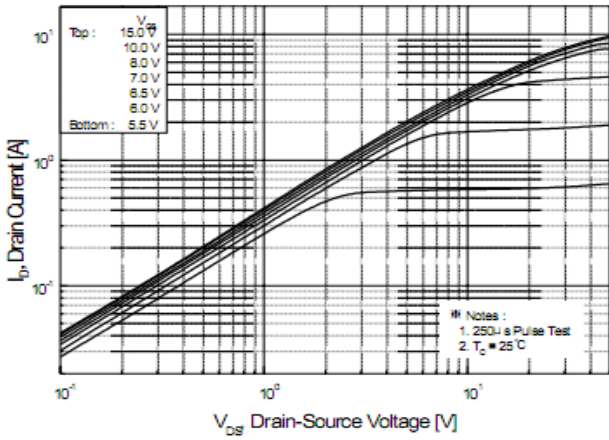


Figure 1. On-Region Characteristics

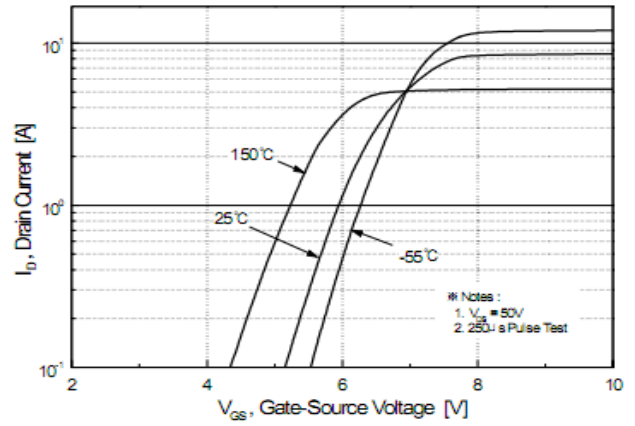


Figure 2. Transfer Characteristics

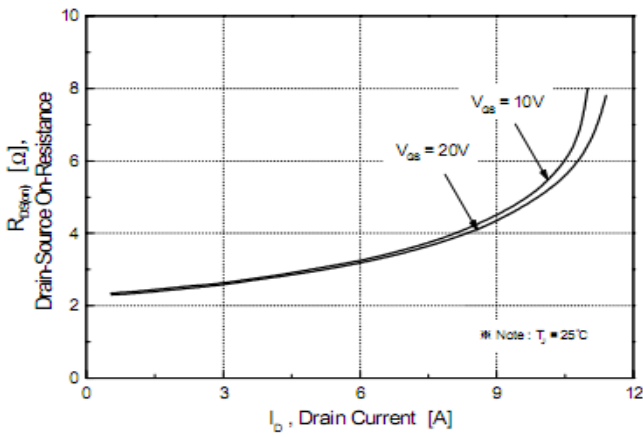


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

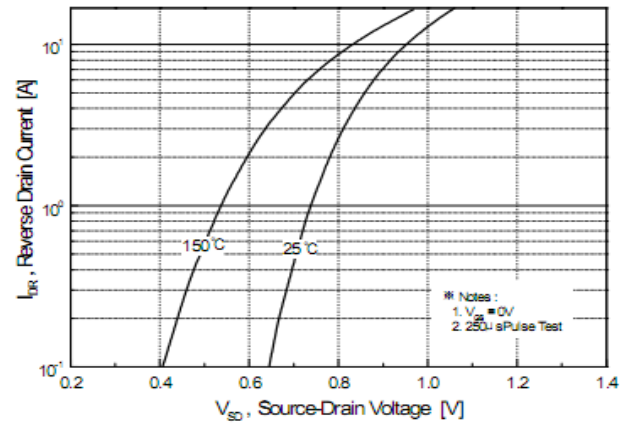


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

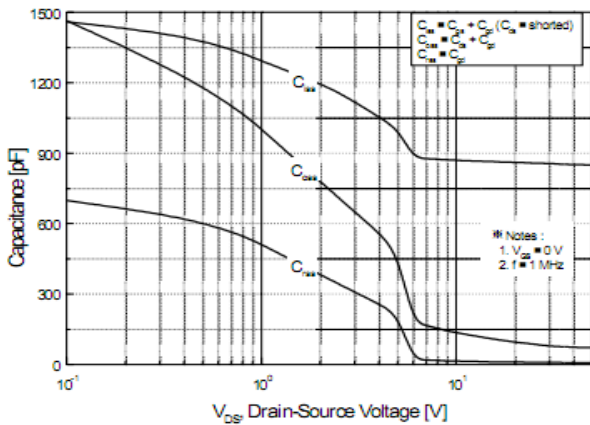


Figure 5. Capacitance Characteristics

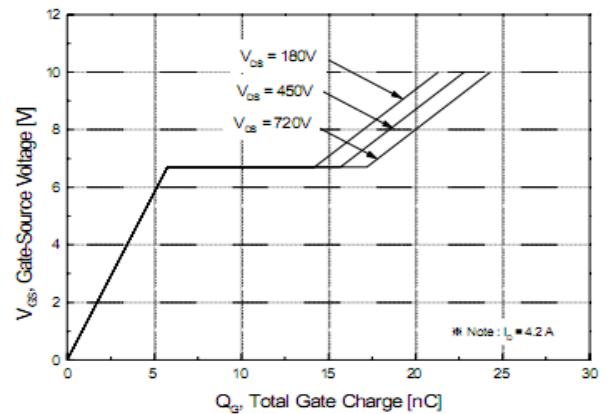


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

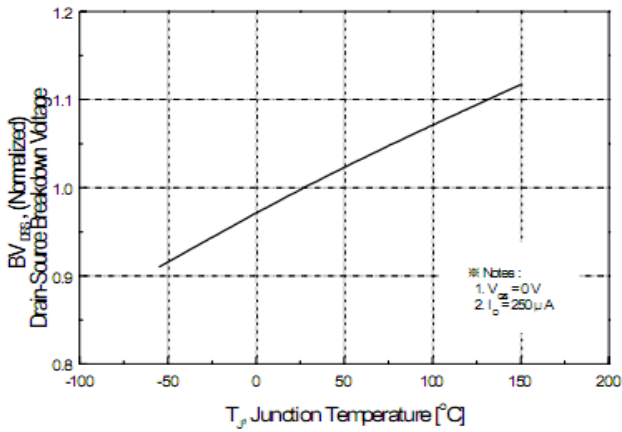


Figure 7. Breakdown Voltage Variation vs Temperature

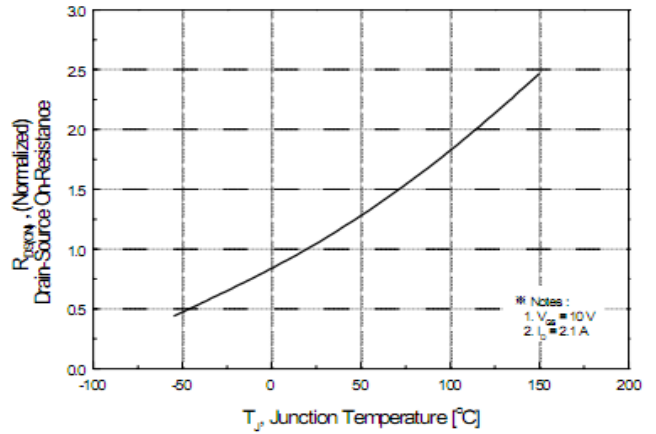


Figure 8. On-Resistance Variation vs Temperature

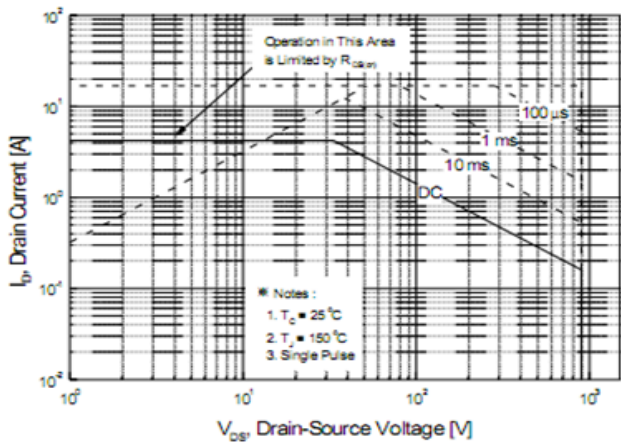


Figure 9-1. Maximum Safe Operating Area for TO220

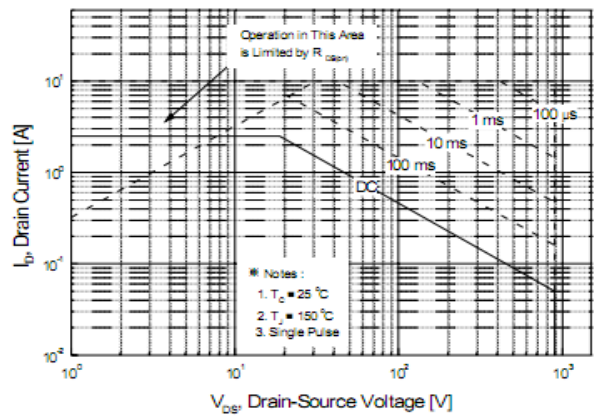


Figure 9-2. Maximum Safe Operating Area for TO220F

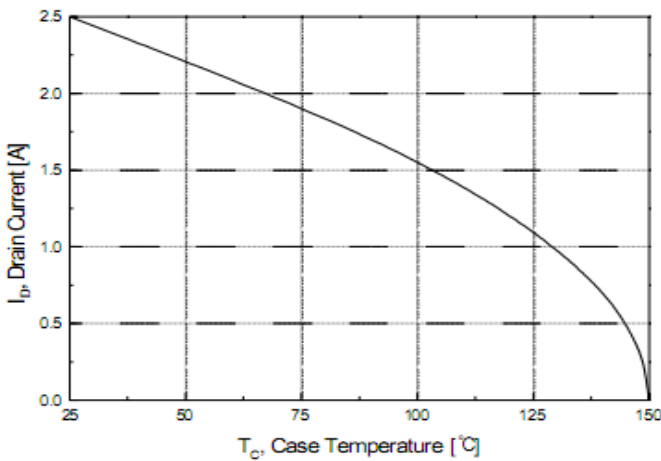


Figure 10. Maximum Drain Current vs Case Temperature

Typical Characteristics (Continued)

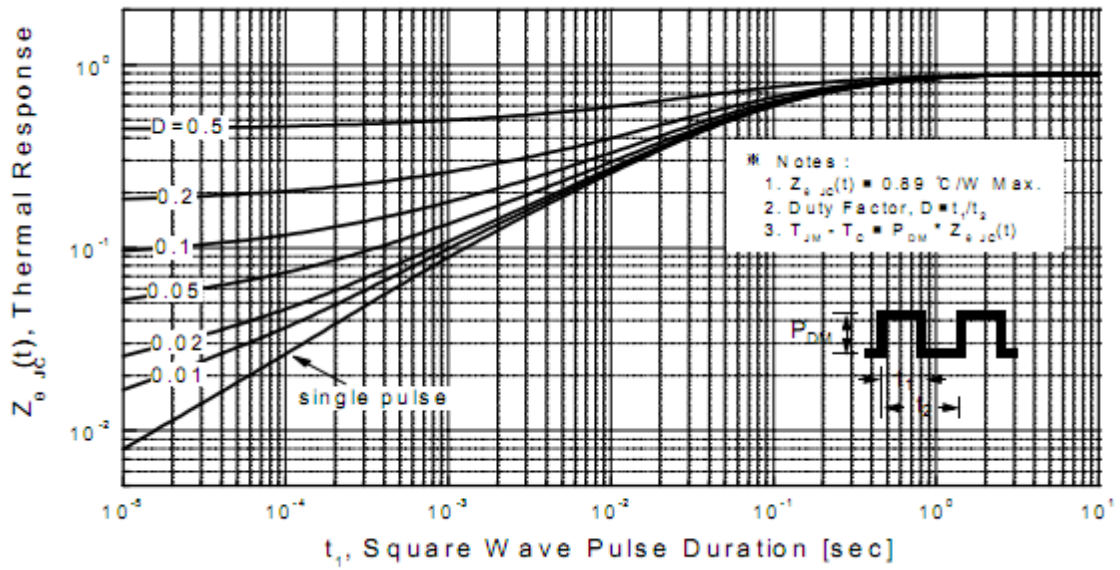


Figure 11-1. Transient Thermal Response Curve for 220

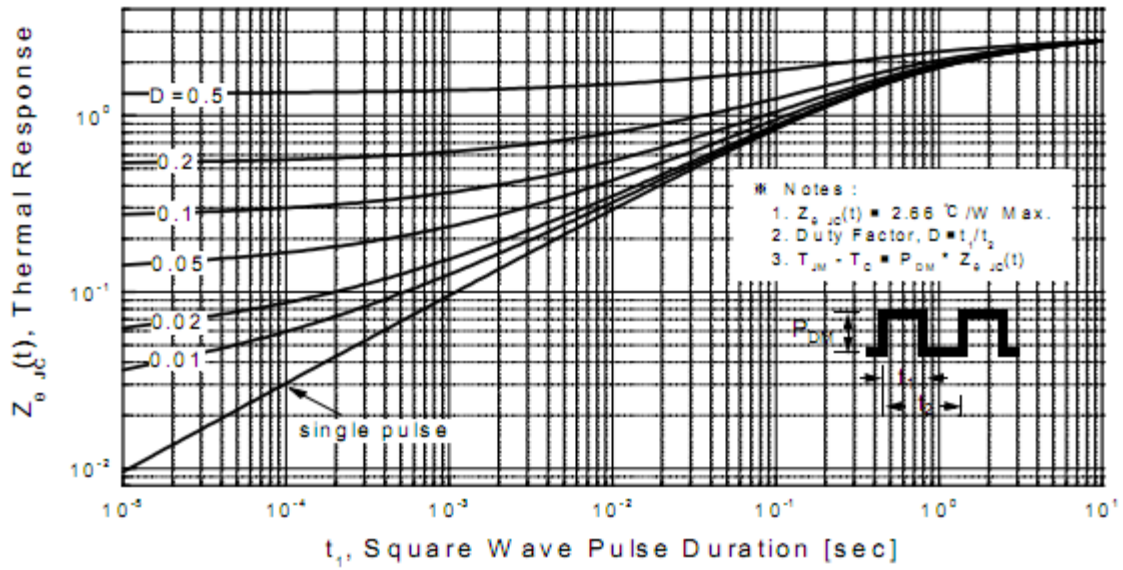
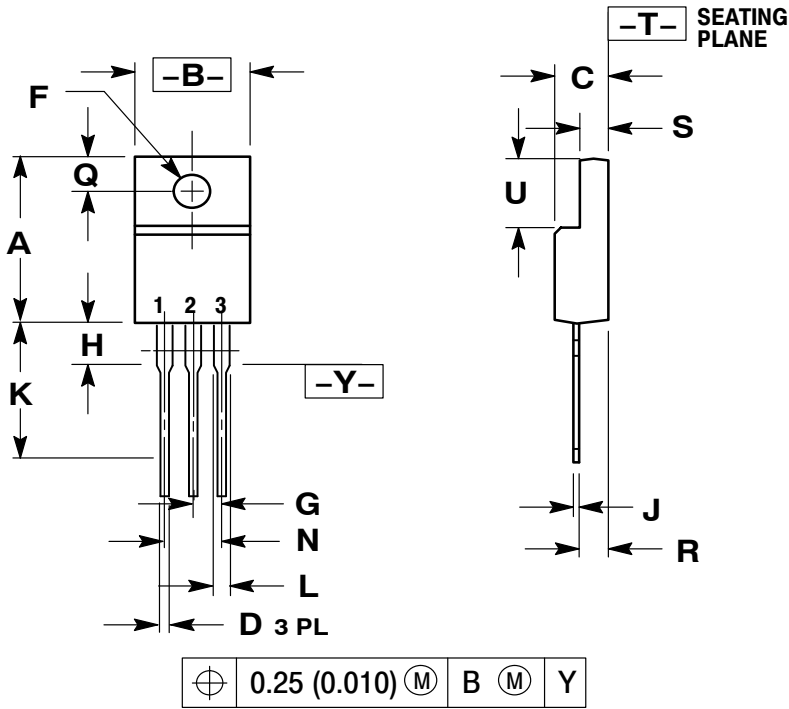


Figure 11-2. Transient Thermal Response Curve for TO220F

Package Dimensions

TO-220F



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH
3. 221D-01 THRU 221D-02 OBSOLETE, NEW STANDARD 221D-03.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.617	0.635	15.67	16.12
B	0.392	0.419	9.96	10.63
C	0.177	0.193	4.50	4.90
D	0.024	0.039	0.60	1.00
F	0.116	0.129	2.95	3.28
G	0.100 BSC		2.54 BSC	
H	0.118	0.135	3.00	3.43
J	0.018	0.025	0.45	0.63
K	0.503	0.541	12.78	13.73
L	0.048	0.058	1.23	1.47
N	0.200 BSC		5.08 BSC	
Q	0.122	0.138	3.10	3.50
R	0.099	0.117	2.51	2.96
S	0.092	0.113	2.34	2.87
U	0.239	0.271	6.06	6.88