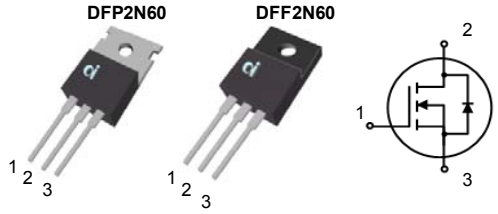
Discrete & Integration SEMICONDUCTOR

DFP2N60/DFF2N60



1. Gate 2. Drain 3. Source

600V 2.4A
High ruggedness N-Channel MOSFET

- ***BV_{DSS} : 600[V]***
- ***I_D : 2.4[A]***
- ***$R_{DS(ON)}$: 5.5[Ω]***
- ***Typical package type : TO220/TO220F***

Features

- $R_{DS(on)}$ (Max 5.5 **Ω**)
- Gate Charge (Typical 15nC)
- Improved dv/dt Capability
- High ruggedness
- 100% Avalanche Tested
- Rohs Compliable
- Halogen Free available

General Description

■ This N-channel enhancement mode field-effect power transistor using DI semiconductor's advanced planar stripe, DMOS technology intended for off-line switch mode power supply. Also, especially designed to minimize rds(on) and high rugged avalanche characteristics.

■ The TO-220 & TO220 full packages are well suited for charger SMPS and small power inverter application.

Absolute Maximum Ratings

Symbol	Parameter	Value		Units
		DFP2N60	DFF2N60	
V_{DSS}	Drain to Source Voltage	600		V
I_D	Continuous Drain Current(@T_C = 25 °C)	2.4	2.4*	A
	Continuous Drain Current(@T_C = 100 °C)	1.5	1.5*	A
I_{DM}	Drain Current Pulsed (Note 1)	9.6	9.6*	A
V_{GS}	Gate to Source Voltage	±30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	140		mJ
E_{AR}	Repetitive Avalanche Energy (Note 1)	2.8		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P_D	Total Power Dissipation(@T_C = 25 °C)	64	28	W
	Derating Factor above 25 °C	0.5	0.21	W/°C
T_{STG}, T_J	Operating Junction Temperature & Storage Temperature	- 55 ~ +150		°C
T_L	Maximum Lead Temperature for soldering purpose, 1/8 from Case for 5 seconds.	300		°C

*. Drain current is limited by junction temperature.

Thermal Characteristics

Symbol	Parameter	Maximum value		Units
		DFP2N60	DFF2N60	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	1.95	4.5	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	62.5	°C/W

Electrical Characteristics (T_C = 25 °C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Off Characteristics						
BV_{DSS}	Drain-Source Breakdown Voltage	V_{GS} = 0V, I_D = 250uA	600	-	-	V
$\Delta BV_{DSS}/\Delta T_J$	Breakdown Voltage Temperature coefficient	I_D = 250uA, referenced to 25 °C	-	0.38	-	V/°C
I_{DSS}	Drain-Source Leakage Current	V_{DS} =600V, V_{GS} = 0V	-	-	1	uA
		V_{DS} = 480V, T_C = 125 °C	-	-	10	uA
I_{GSS}	Gate-Source Leakage, Forward	V_{GS} = 30V, V_{DS} = 0V	-	-	100	nA
	Gate-source Leakage, Reverse	V_{GS} = -30V, V_{DS} = 0V	-	-	-100	nA
On Characteristics						
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}, I_D = 250uA	2.0	-	4.0	V
$R_{DS(ON)}$	Static Drain-Source On-state Resistance	V_{GS} =10 V, I_D =1.2A	-	4.5	5.5	Ω
Dynamic Characteristics						
C_{iss}	Input Capacitance	V_{GS} =0 V, V_{DS} =25V, f = 1MHz	-	570	720	pF
C_{oss}	Output Capacitance		-	150	215	
C_{rss}	Reverse Transfer Capacitance		-	310	450	
Dynamic Characteristics						
$t_{d(on)}$	Turn-on Delay Time	V_{DD} =300V, I_D =2.4A, R_G =25Ω ※ **see fig. 13.** (Note 4, 5)	-	15	40	ns
t_r	Rise Time		-	75	160	
$t_{d(off)}$	Turn-off Delay Time		-	30	60	
t_f	Fall Time		-	35	80	
Q_g	Total Gate Charge	V_{DS} =480V, V_{GS} =10V, I_D =2.4A ※ **see fig. 12.** (Note 4, 5)	-	15	20	nC
Q_{gs}	Gate-Source Charge		-	1.6	-	
Q_{gd}	Gate-Drain Charge(Miller Charge)		-	6	-	

Source-Drain Diode Ratings and Characteristics

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit.
I_S	Continuous Source Current	Integral Reverse p-n Junction Diode in the MOSFET	-	-	2.4*	A
I_{SM}	Pulsed Source Current		-	-	9.6*	
V_{SD}	Diode Forward Voltage	I_S =2.4A, V_{GS} =0V	-	-	1.5	V
t_{rr}	Reverse Recovery Time	I_S=2.4A, V_{GS}=0V, dI_F/dt=100A/us	-	600	-	ns
Q_{rr}	Reverse Recovery Charge		-	1.1	-	uC

※ NOTES
1. Repeativity rating : pulse width limited by junction temperature
2. L =44.7mH, I_{AS} =2.4A, V_{DD} = 50V, R_G = 50Ω, Starting T_J = 25°C
3. I_{SD} ≤ 2.4A, di/dt ≤ 300A/us, V_{DD} ≤ BV_{DSS}, Starting T_J = 25°C
4. Pulse Test : Pulse Width ≤ 300us, Duty Cycle ≤ 2%
5. Essentially independent of operating temperature.

Fig 1. On-State Characteristics

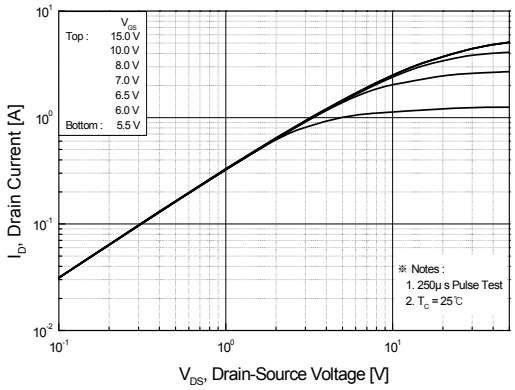


Fig 2. Transfer Characteristics

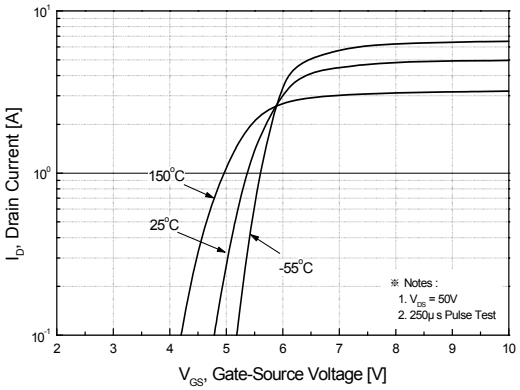


Fig 3. On Resistance Variation vs. Drain Current and Gate Voltage

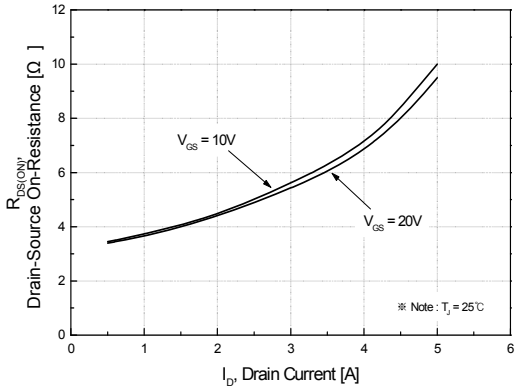


Fig 4. On State Current vs. Allowable Case Temperature

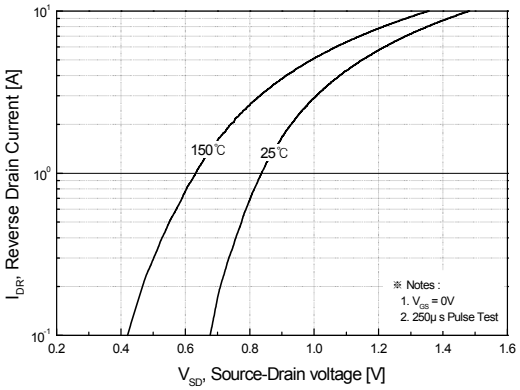


Fig 5. Capacitance Characteristics (Non-Repetitive)

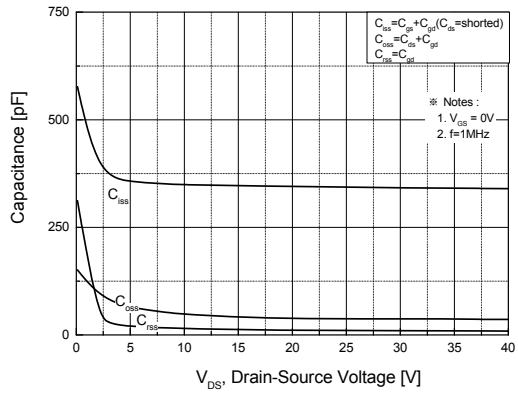


Fig 6. Gate Charge Characteristics

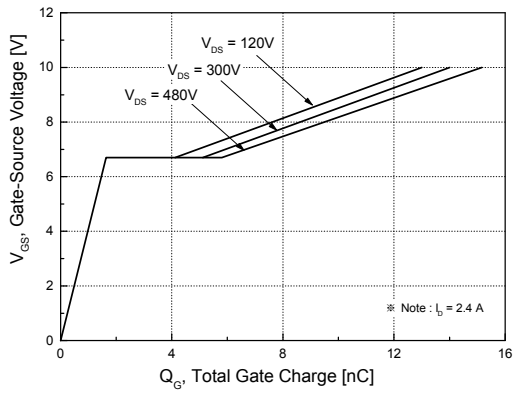


Fig 7. Breakdown Voltage Variation vs. Junction Temperature

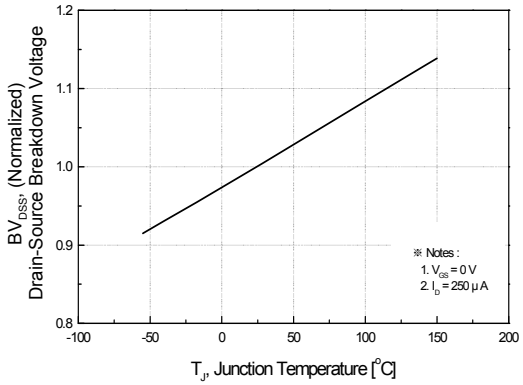


Fig 8. On-Resistance Variation vs. Junction Temperature

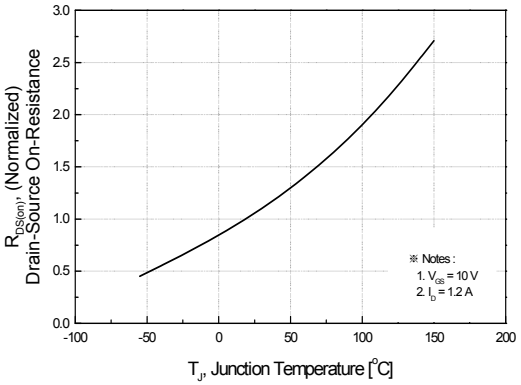


Fig 9. Maximum Safe Operating Area

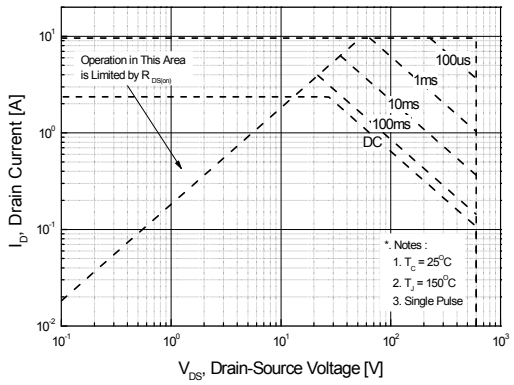


Fig 10. Maximum Safe Operating Area

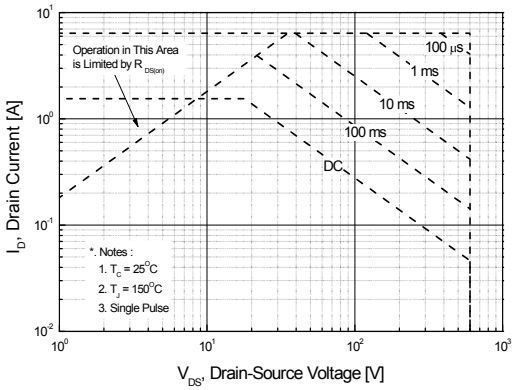


Fig 11. Maximum Drain Current vs. Case Temperature. (TO220)

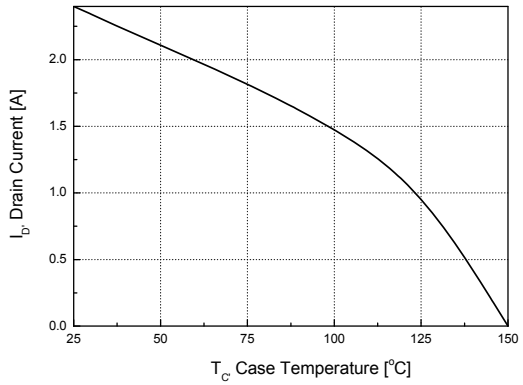


Fig 12. Maximum Drain Current vs. Case Temperature. (TO220F)

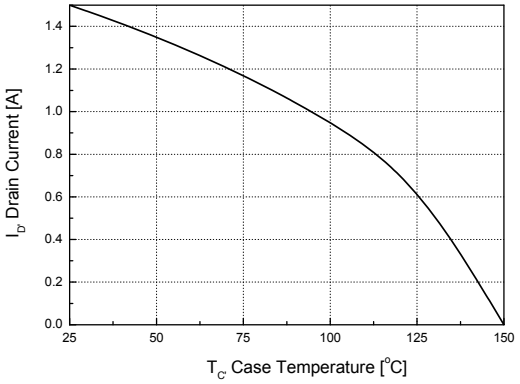


Fig 13. Transient Thermal Response Curve(TO220)

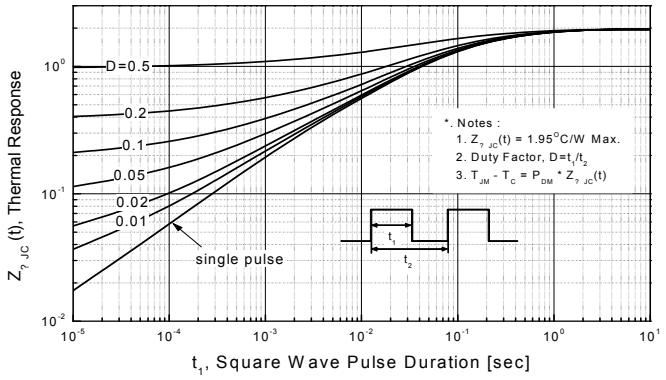


Fig 14. Transient Thermal Response Curve(TO220F)

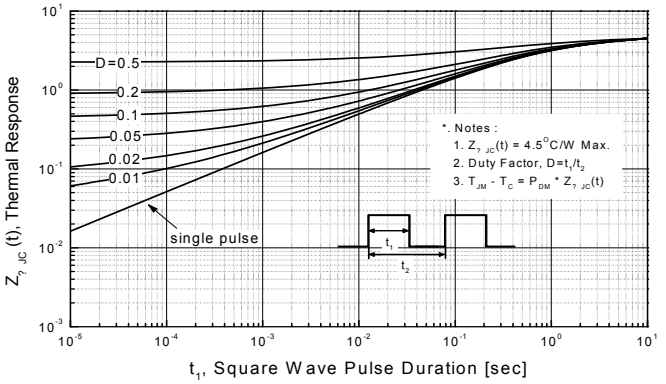


Fig. 12. Gate Charge Test Circuit & Waveforms

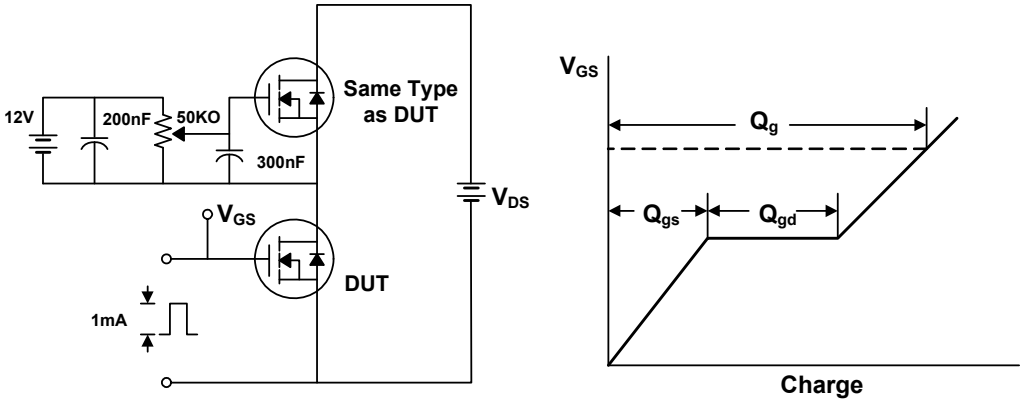


Fig 13. Switching Time Test Circuit & Waveforms

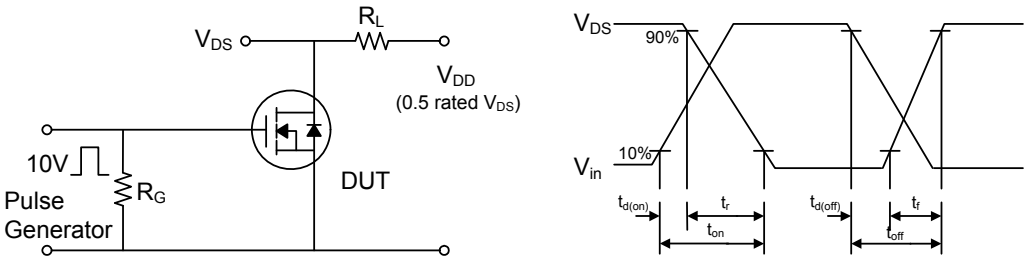


Fig 14. Unclamped Inductive Switching Test Circuit & Waveforms

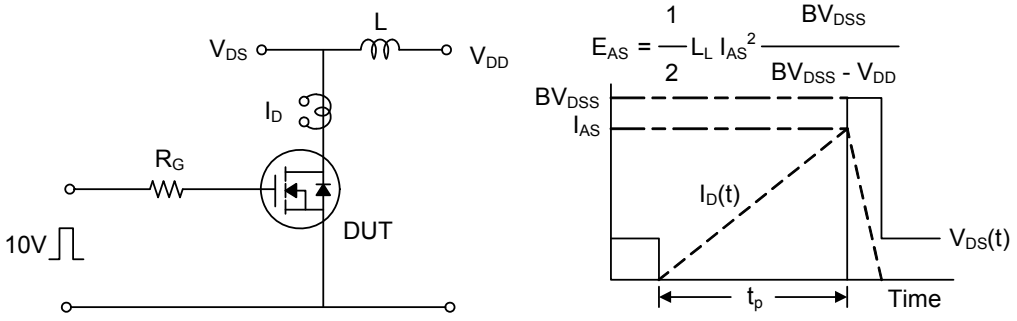
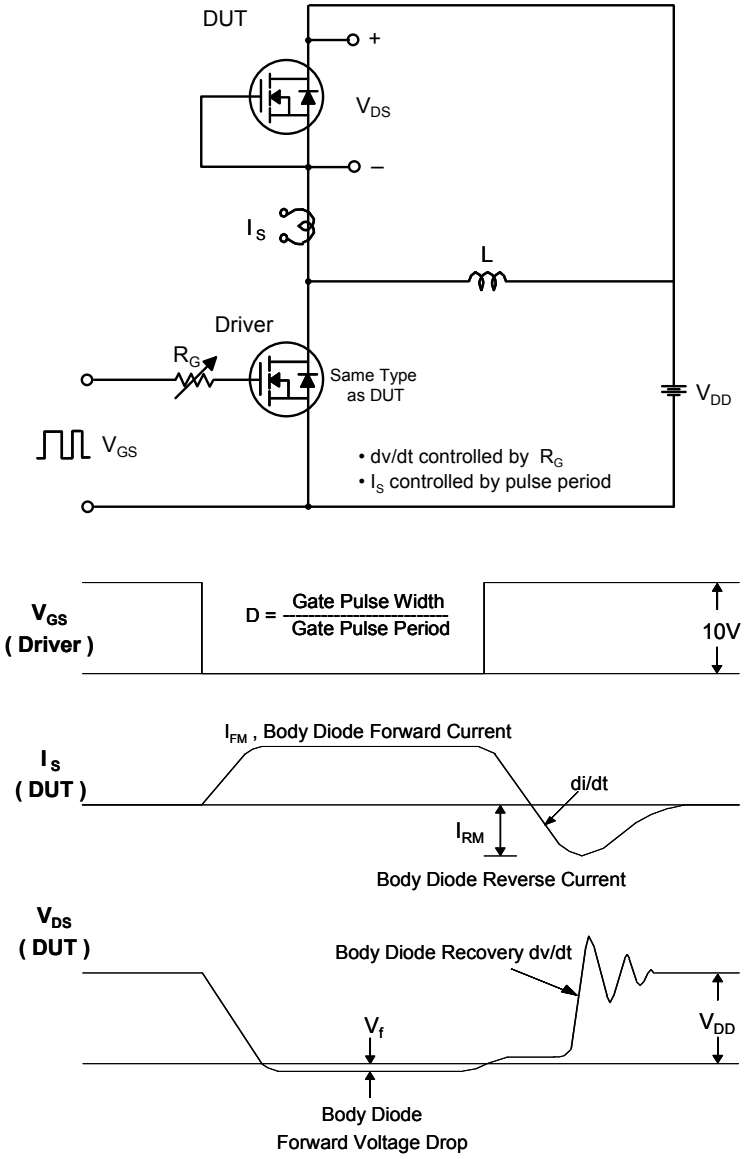
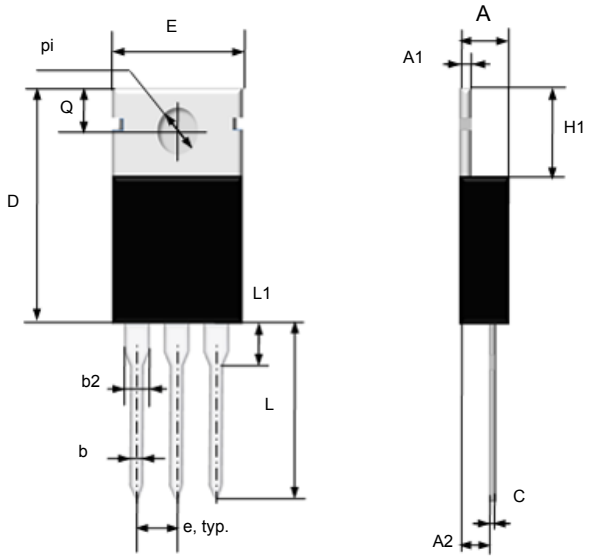


Fig. 15. Peak Diode Recovery dv/dt Test Circuit & Waveforms

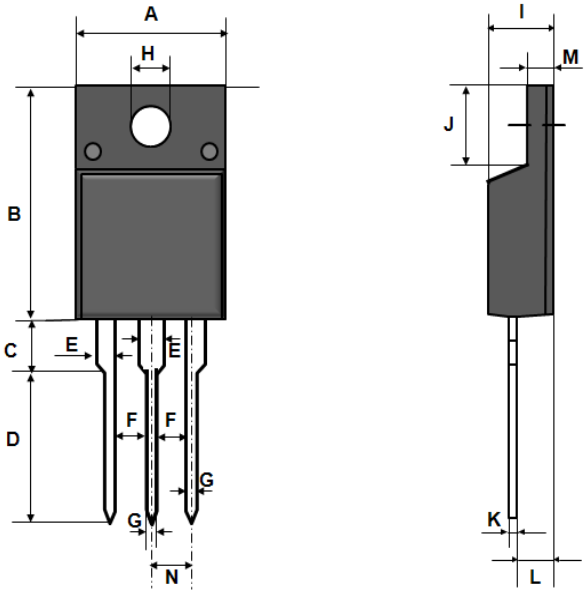


TO-220 Package Dimension



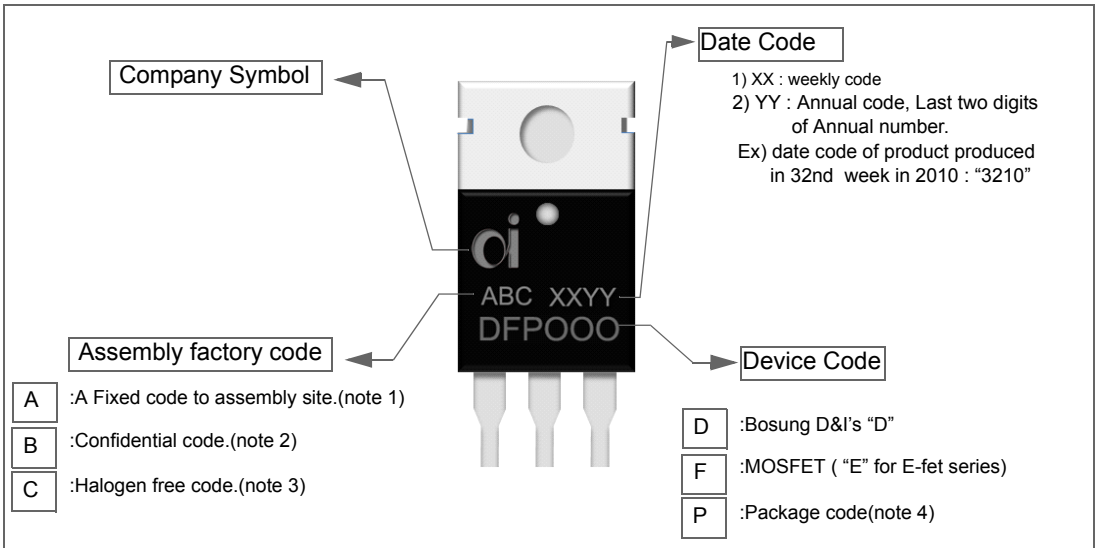
Symbol	INCHES			MILLIMETERS		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	0.14	0.165	0.19	3.56	4.195	4.83
A1	0.02	0.038	0.055	0.51	0.955	1.4
A2	0.08	0.098	0.115	2.03	2.475	2.92
b	0.015	0.028	0.04	0.38	0.7	1.02
b2	0.045	0.058	0.07	1.14	1.46	1.78
c	0.014	0.019	0.024	0.36	0.485	0.61
D	0.56	0.605	0.65	14.22	15.365	16.51
e	0.096	0.1	0.104	2.44	2.54	2.64
E	0.38	0.4	0.42	9.65	10.16	10.67
H1	0.23	0.25	0.27	5.84	6.35	6.86
L	0.5	0.54	0.58	12.7	13.715	17.73
L1	-	-	0.25	-	-	6.35
pi	0.139	0.15	0.161	3.53	3.81	4.09
Q	0.1	0.118	0.135	2.54	2.985	3.43

TO-220F Package Dimension



Symbol	INCHES			MILLIMETERS		
	MIN	TYP	MAX		MIN	TYP
A	9.88	10.08	10.28	25.10	25.60	26.11
B	15.30	15.50	15.70	38.86	39.37	39.88
C	2.95	3.00	3.05	7.49	7.62	7.75
D	10.30	10.50	10.70	26.16	26.67	27.18
E	0.95	1.08	1.20	2.41	2.74	3.05
F	1.81	1.84	1.87	4.60	4.67	4.75
G	0.50	0.70	0.90	1.27	1.78	2.29
H	3.00	3.20	3.40	7.62	8.13	8.64
I	4.35	4.45	4.55	11.05	11.30	11.56
J	6.20	6.40	6.60	15.75	16.26	16.76
K	0.41	0.51	0.61	1.03	1.28	1.54
L	2.30	2.50	2.70	5.84	6.35	6.86
M	2.53	2.73	2.93	6.43	6.93	7.44
N	2.34	2.54	2.74	5.94	6.45	6.96

Marking layout & Ordering(TO220)



<Note>
1. Assembly site code is an alphabetic code and fixed according to assembly site.
2. Confidential code is to protect D&I's product from imitation product and to control production.
3. Haloen free code is one of "N" or "F". "**N**" is a code for **N**on-halogen free product and "**F**" is for halogen **F**ree product.
4. Package codes to package types are "P" for TO220, "F" for TO220F, "U" for TO251, "D" for TO252, "B" for TO263, "R" for TO126, "W" for TO247/TO3P, "K" for SOT89, "N" for TO92, "L" for TO264.
5. This new marking layout for halogen free product has been applied to product which has been produced since 2009 .

Ordering for halogen free product

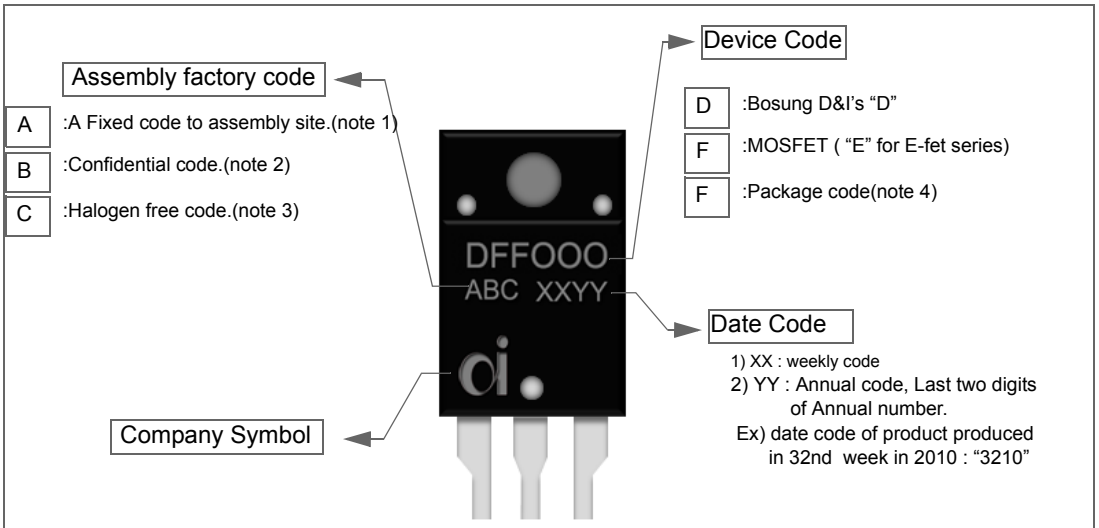
1. Halogen free product's device code on marking layout is same with non-halogen free product's device code.
2. In ordering, Halogen free product's ordering code is different from the ordering code for non-halogen free product.
   2.1. Ordering code for non-halogen free product : Device name
   2.2. Ordering code for halogen free product : Device name + "-HF"
   As an example, DFF4N60-HF. DEP50N06-HF
3. How to discriminate Halogen free product from non-halogen free product.
   3.1. See "Assembly factory code" in marking layout.

How to contact us

■ Headquarters :
Address : 201-1410, Chunui-Techono park II, Chunui-dong, Wonmi-gu, Bucheon-si, Korea. P.C. 420-857.
TEL. +82-32-623-0145, FAX. +82-32-623-0148.
Website : http://www.dnisemi.com.

■ Contact person :
Juliet Kim, Sales assistant, hhkim@dnisemi.com / Shon Go, Technical support, shgo@dnisemi.com.

Marking layout & Ordering(TO220F)



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