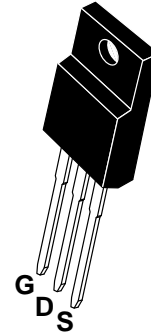




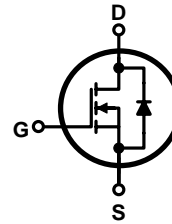
PIN Connection TO-220F

FEATURE

- 10A,650V, $R_{DS(ON)MAX}=1.0\ \Omega$  @ $V_{GS}=10V/5A$
- Low gate charge
- Low  $C_{iss}$
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability
- Halogen free



Schematic diagram



Marking Diagram



- Y = Year
- A = Assembly Location
- WW = Work Week
- VT = Version & Thickness
- FIR10N65F = Specific Device Code

**Absolute Maximum Ratings**( $T_c=25^\circ C$ , unless otherwise noted)

Parameter	Symbol		UNIT
Drain-Source Voltage	$V_{DSS}$	650	V
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	
Continuous Drain Current	$I_D$	10	A
Pulsed Drain Current(Note1)	$I_{DM}$	40	
Single Pulse Avalanche Energy (Note 2)	$E_{AS}$	500	mJ
Reverse Diode dV/dt (Note 3)	dv/dt	5	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55to+150	$^\circ C$
Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	$T_L$	260	$^\circ C$

Parameter	Symbol		Units
Thermal resistance , Channel to Case	$R_{th(ch-c)}$	3.13	$^\circ C/W$
Thermal resistance , Channel to Ambient	$R_{th(ch-a)}$	62.5	$^\circ C/W$
Maximum Power Dissipation $T_c=25^\circ C$	$P_D$	40	W

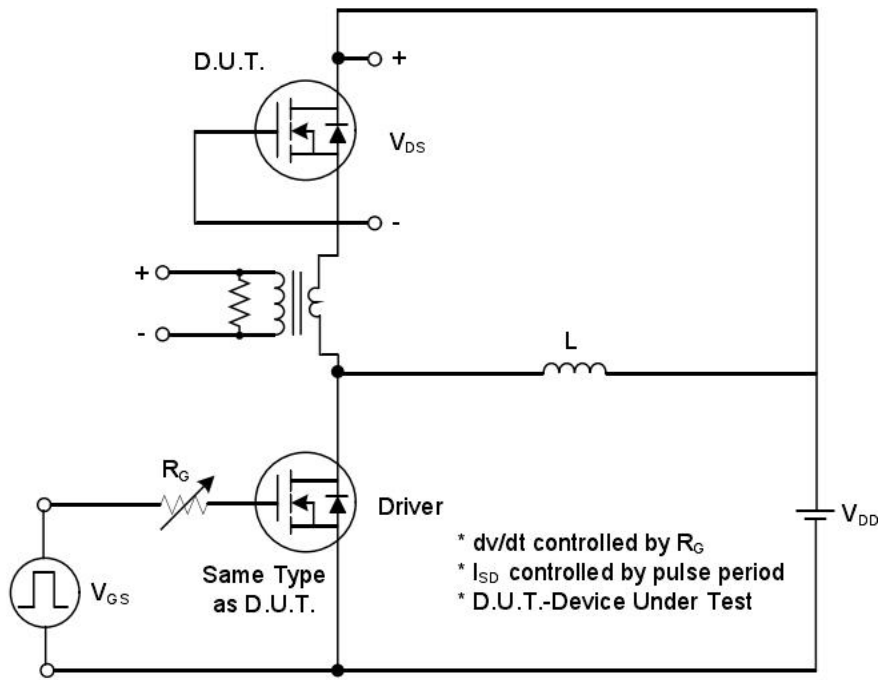


Electrical Characteristics (T <sub>c</sub> =25°C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V, I <sub>D</sub> =250uA	650	—	—	V
Breakdown Temperature Coefficient	ΔBV <sub>DSS</sub> / ΔT <sub>J</sub>	Reference to 25°C , I <sub>D</sub> =250uA	—	0.7	—	V/°C
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> =650V, V <sub>GS</sub> =0V	—	—	1	uA
Gate-Body Leakage Current, Forward	I <sub>GSSF</sub>	V <sub>GS</sub> =30V, V <sub>DS</sub> =0V	—	—	100	nA
Gate-Body Leakage Current, Reverse	I <sub>GSSR</sub>	V <sub>GS</sub> =-30V, V <sub>DS</sub> =0V	—	—	-100	nA
<b>On Characteristics</b>						
Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250uA	2	—	4	V
Drain-Source On-State Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =5A	—	0.86	1.0	Ω
<b>Dynamic Characteristics</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V, V <sub>GS</sub> =0V, f=1.0MHZ	—	1642	—	pF
Output Capacitance	C <sub>oss</sub>		—	128	—	pF
Reverse Transfer Capacitance	C <sub>rss</sub>		—	7	—	pF
<b>Switching Characteristics</b>						
Turn-On Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =325V, I <sub>D</sub> =10A, R <sub>G</sub> =10Ω (Note3,4)	—	27	—	ns
Turn-On Rise Time	t <sub>r</sub>		—	22	—	ns
Turn-Off Delay Time	t <sub>d(off)</sub>		—	53	—	ns
Turn-Off Fall Time	t <sub>f</sub>		—	24	—	ns
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =520V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V, (Note3,4)	—	32	—	nC
Gate-Source Charge	Q <sub>gs</sub>		—	8	—	nC
Gate-Drain Charge	Q <sub>gd</sub>		—	12	—	nC
<b>Drain-Source Body Diode Characteristics and Maximum Ratings</b>						
Continuous Diode Forward Current	I <sub>S</sub>		—	—	10	A
Pulsed Diode Forward Current	I <sub>SM</sub>		—	—	40	A
Diode Forward Voltage	V <sub>SD</sub>	I <sub>S</sub> =10A, V <sub>GS</sub> =0V	—	—	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =10A, dI <sub>F</sub> /dt=100A/us, (Note4)	—	528	—	ns
Reverse Recovery Charge	Q <sub>rr</sub>		—	3.22	—	uC

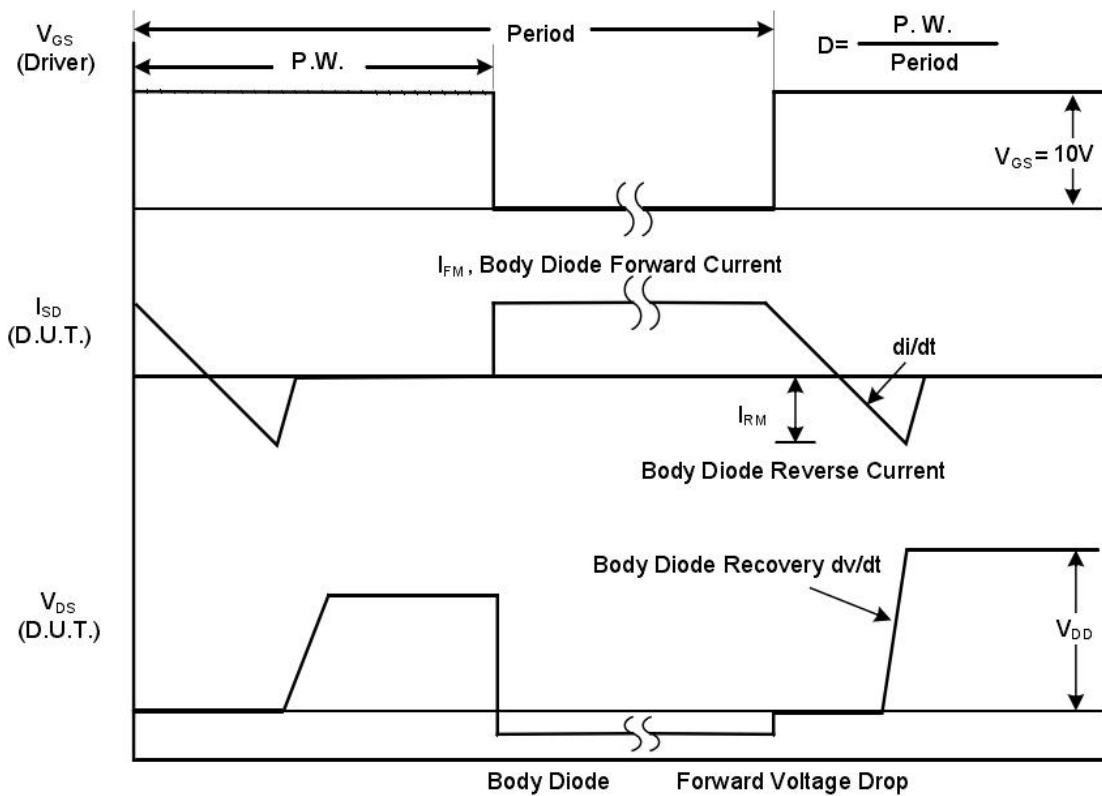
**Notes**

1. Repetitive Rating; pulse width limited by maximum junction temperature.
2. L=10mH, I<sub>AS</sub>=10A , starting T<sub>J</sub>=25°C .
3. I<sub>SD</sub>=10A, dI/dt ≤ 100A/us, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, starting T<sub>J</sub>=25°C , Pulse width ≤ 300us; duty cycle ≤ 2%.
4. Repetitive rating; pulse width limited by maximum junction temperature.

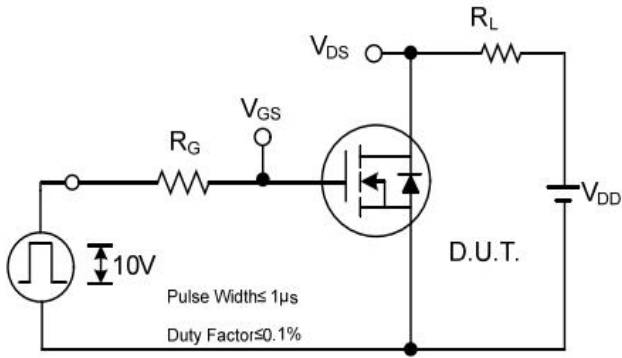
TEST CIRCUIT AND WAVEFORM



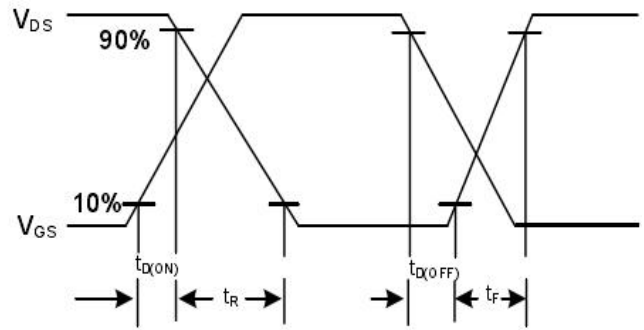
Peak Diode Recovery dv/dt Test Circuit



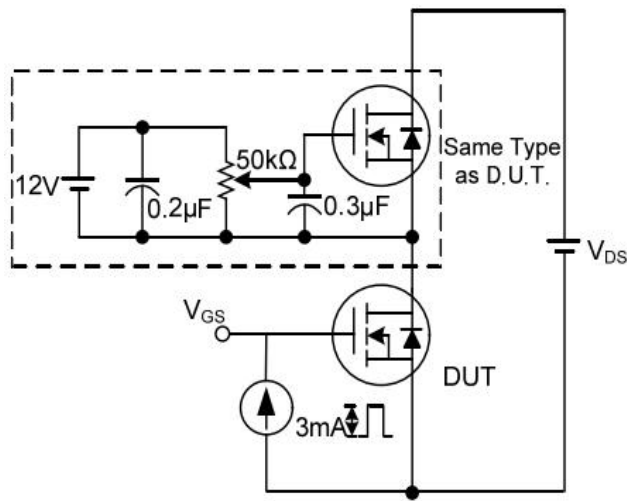
Peak Diode Recovery dv/dt Waveforms



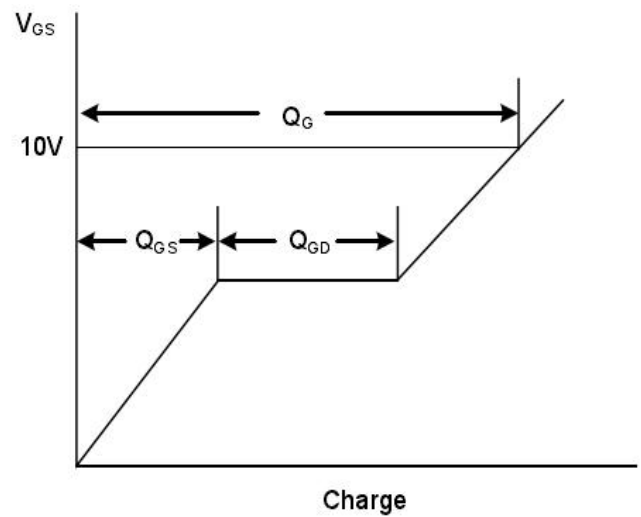
Switching Test Circuit



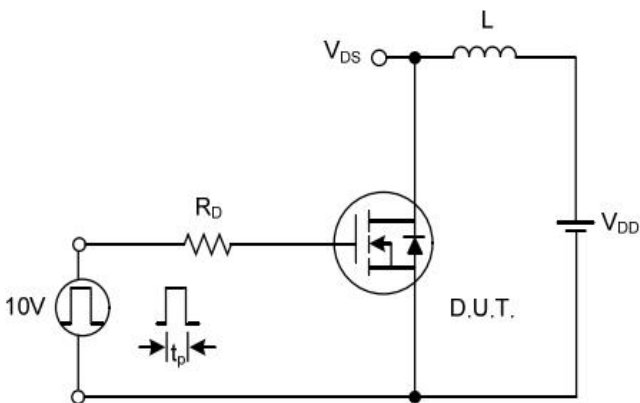
Switching Waveforms



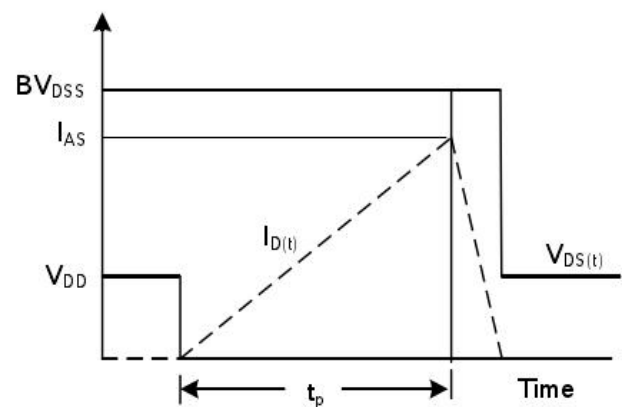
Gate Charge Test Circuit



Gate Charge Waveform



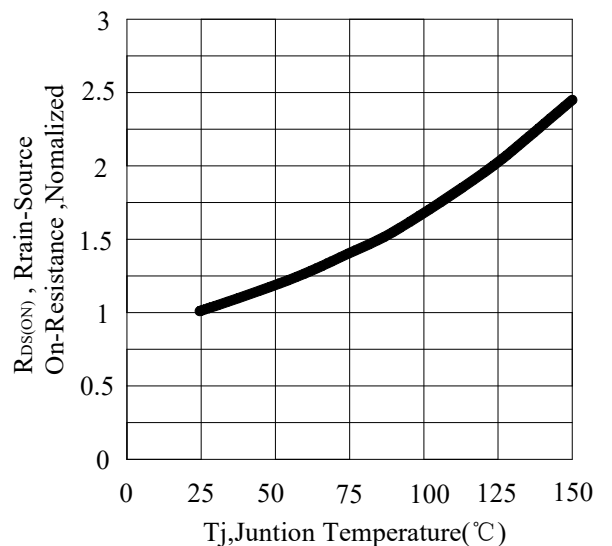
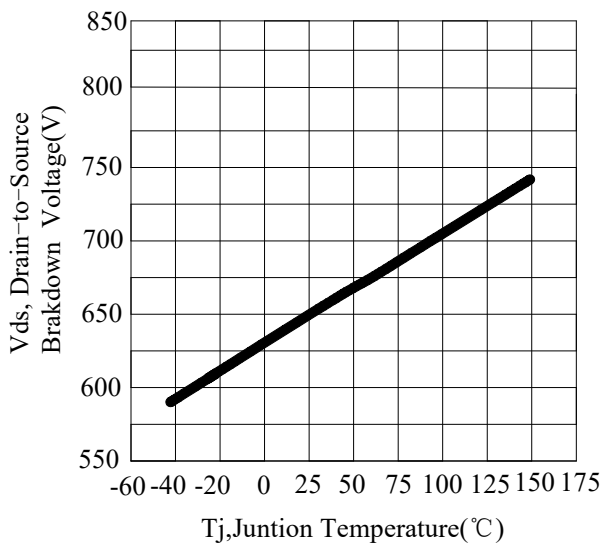
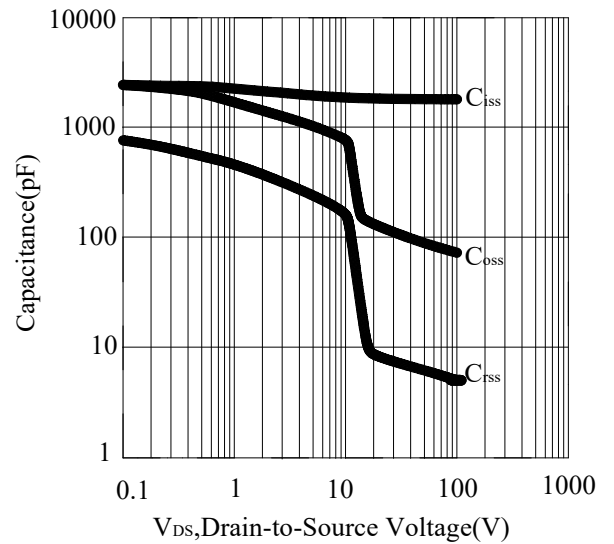
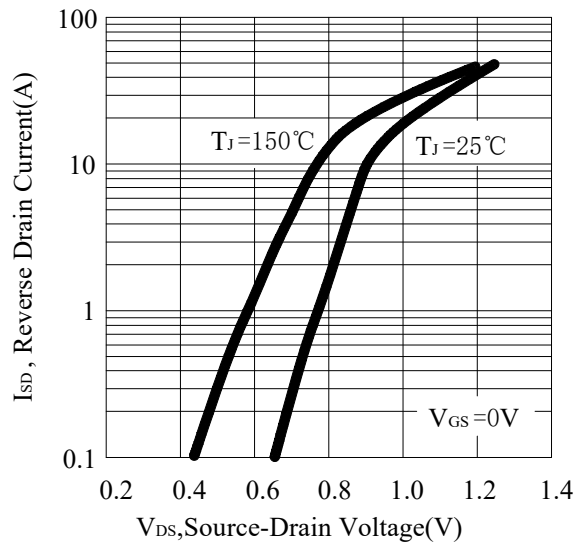
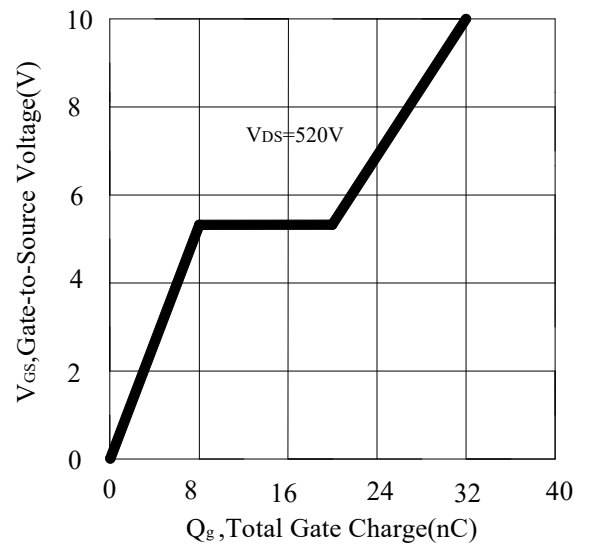
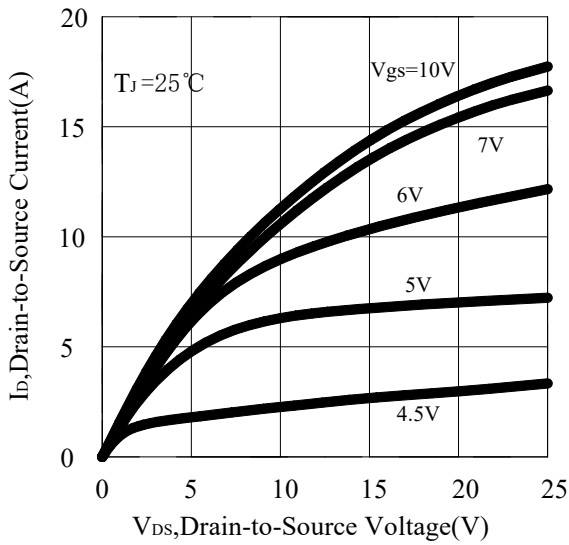
Unclamped Inductive Switching Test Circuit

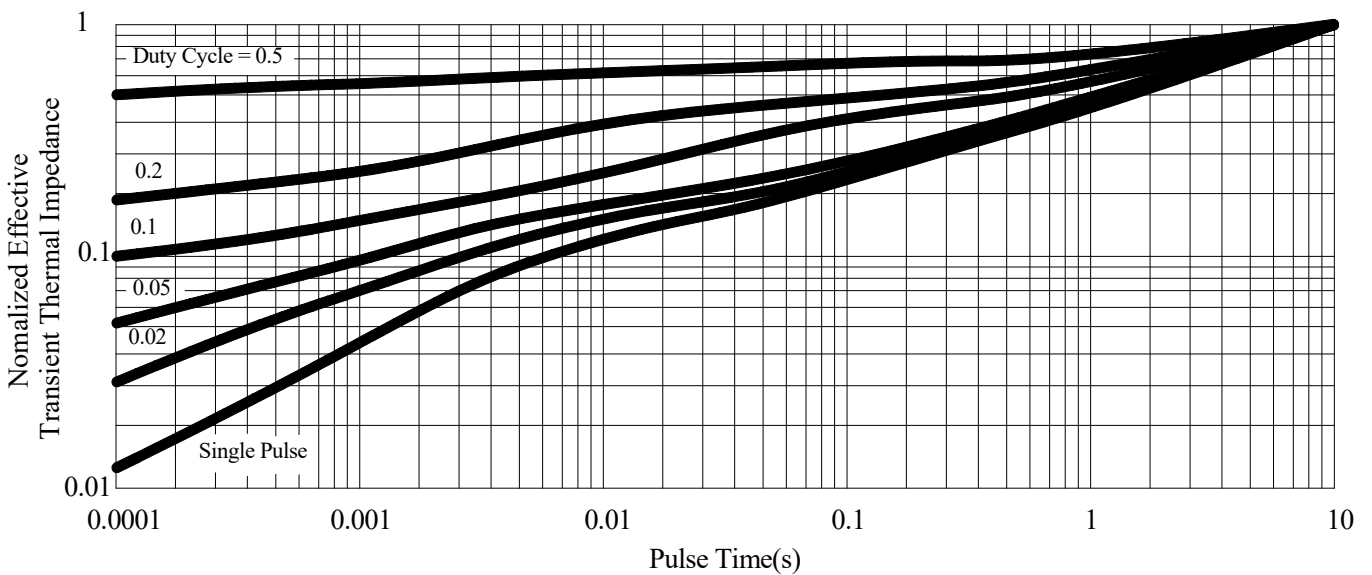
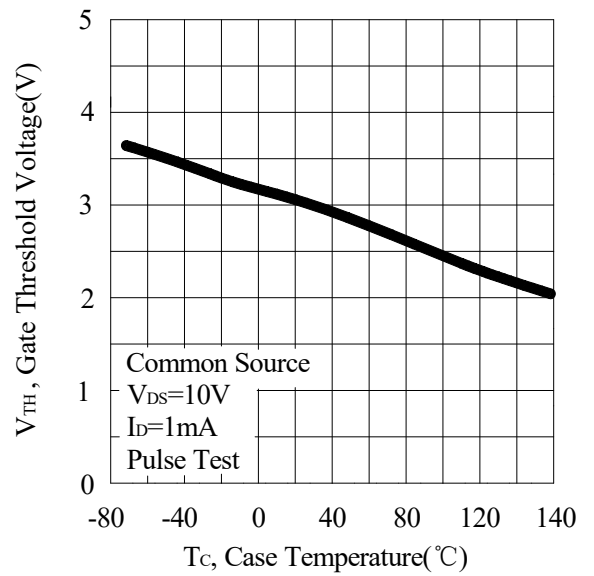
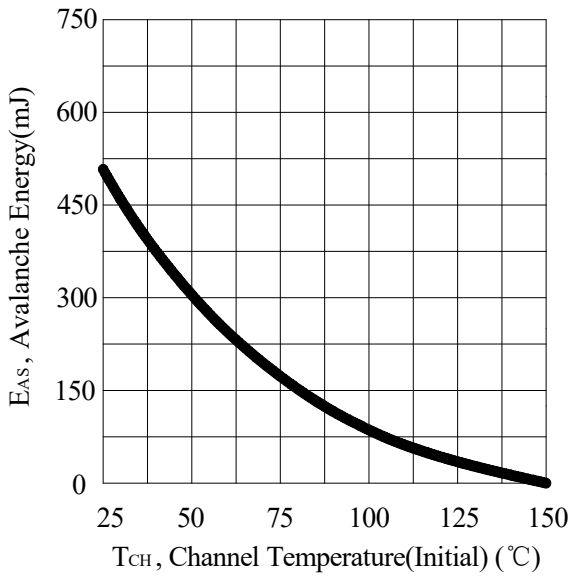
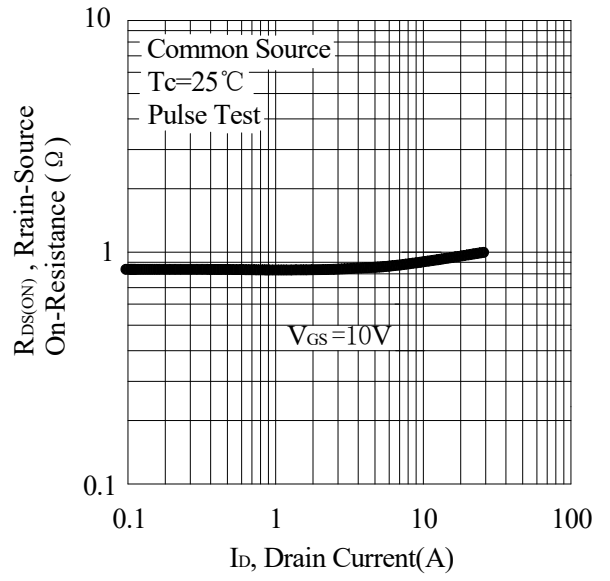
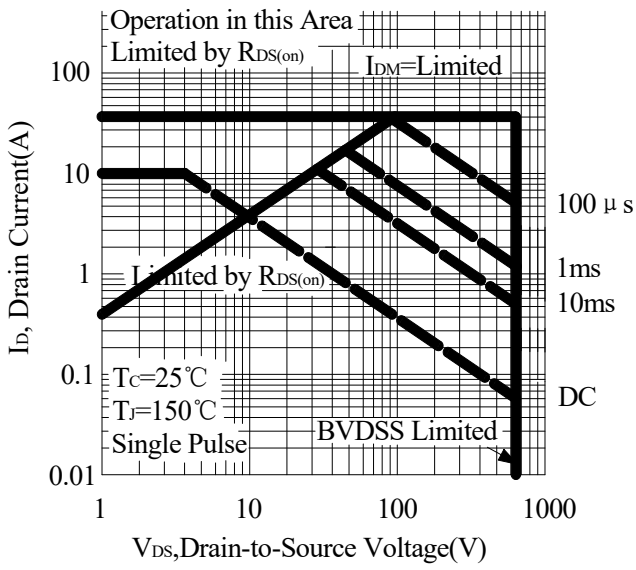


Unclamped Inductive Switching Waveforms



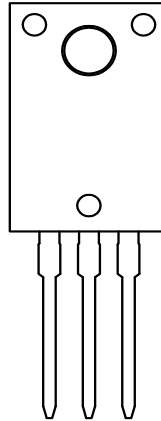
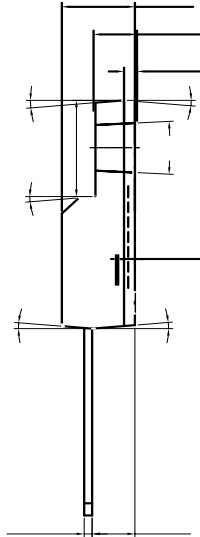
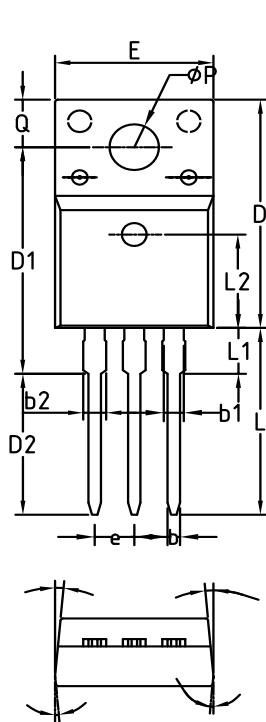
RATING AND CHARACTERISTIC CURVES





Package Information

TO i220F



8 Q L V P V P  
COMMON DIMENSIONS  
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.96
b	0.70	0.80	0.90
b1	1.17	1.2	1.25
b2	1.17	1.2	1.25
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	10.0	10.2	10.4
E	9.96	10.16	10.36
e	2.54BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	-	-	3.50
L2	6.50REF		
phi P	3.08	3.18	3.28
Q	3.20	3.30	3.40
	1°	3°	5°
	0.53	0.56	0.59

'HFODUDWLRQ

z FIRST reserves the right to change the specifications, the same specifications of products due to different packaging line mold, the size of the appearance will be slightly different, shipped in kind, without notice! Customers should obtain the latest version information before ordering, and verify whether the relevant information is complete and up-to-date.

z \$Q\ VHPLFRQGXFWRU SURGXFV XQGHU FHUWDLQ FRQGLWLRQV KDV WKH  
 UHVSRQVLELOLW\ WR FRPSO\ ZLWK VDIHW\  
 VWDQGDUGV DQG WDNH VDIHW\ PHDVXUHV ZKHQ XVLQJ ),567 SURGXFV  
 DYRLG DYRLG SRWHQWLDO IDLOXUH ULVNV ZKLFK PD\ FDXVH SHUVRQDO  
 z 3URGXFV SURPRWLRQ HQGOHVV RXU FRPSDQ\ ZLOO ZKROHKHDUWHGO\ S

Revision History

Date	REV	Description	Page
2021.01.01	1.0	Initial release	