General Description

The HPC60R140B is a high voltage power MOSFET, fabricated using advanced super junction technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density and outstanding efficiency.

The HPC60R140B break down voltage is 600V and it has a high rugged avalanche characteristics.

The HPC60R140B is available in TO-220F, TO-220C, TO-263-2 and TO-247 packages.

Features

- Ultra Low $R_{DS(ON)}$ = 140mΩ @ V_{GS} = 10V.
- Ultra Low Gate Charge, Qg=40.4nC typ.
- Intrinsic Fast-Recovery Body Diode
- Fast switching capability
- Robust design with better EAS performance

Application

- AC/DC Power Supply
- PC Power
- Sever / Telecom
- Solar Inverter

Symbol

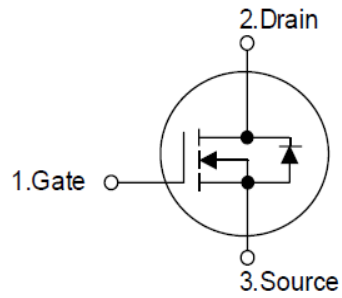


Figure 1 Symbol of HPC60R140B

Package Type

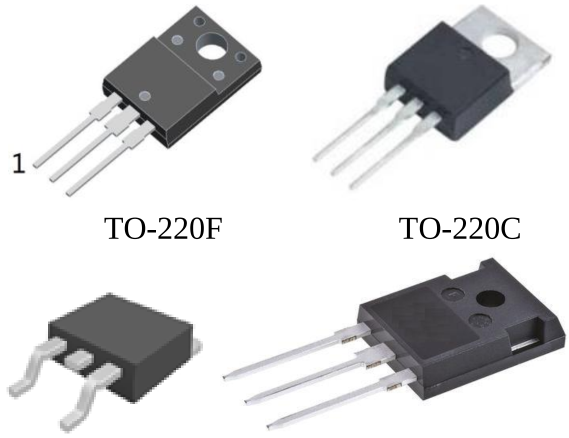


Figure 2 Package Types of HPC60R140B

Ordering Information

HPC60R140B□□–□

Circuit Type

Package
TF: TO-220F
TC: TO-220C
S2: TO-263-2
T: TO-247

E: Lead Free
G: Green

Blank: Tube
TR: Tape & Reel

Package	Part Number		Marking ID		Packing Type
	Lead Free	Green	Lead Free	Green	
TO-220F	HPC60R140BTF-E	HPC60R140BTF-G	HPC60R140BTFE	HPC60R140BTFG	Tube
TO-220C	HPC60R140BTC-E	HPC60R140BTC-G	HPC60R140BTC E	HPC60R140BTC G	Tube

TO-263-2	HPC60R140BS2TR-E	HPC60R140BS2TR-G	HPC60R140BS2E	HPC60R140BS2G	Tape & Reel
TO-247	HPC60R140BT-E	HPC60R140BT-G	HPC60R140BTE	HPC60R140BTG	Tube

Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Drain-Source Voltage		V_{DSS}	600	V
Gate-Source Voltage		V_{GSS}	±30	V
Continuous Drain Current	T_C=25ºC	I_D	25.0	A
	T_C=125ºC		11.2	
Pulsed Drain Current (Note 2)		I_{DM}	76	A
Avalanche Energy, Single Pulse (Note 3)		E_{AS}	510	mJ
Avalanche Energy, Repetitive (Note 2)		E_{AR}	0.7	mJ
Avalanche Current, Repetitive (Note 2)		I_{AR}	3.6	A
Continuous Diode Forward Current		I_S	25.0	A
Diode Pulse Current		$I_{S.PULSE}$	76	A
MOSFET dv/dt Ruggedness, V_{DS}<=480V		dv/dt	50	V/ns
Reverse Diode dv/dt, V_{DS}<=480V, I_{SD}<=I_D		dv/dt	50	V/ns
Power Dissipation（TO-220F）		P_{tot}	34.7	W
Operating Junction Temperature		T_J	150	ºC
Storage Temperature		T_{STG}	-55 to 150	ºC
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260	ºC

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3. I_{AS} = 3.6A, V_{DD} = 60V, R_G = 25Ω, Starting T_J = 25°C

Thermal characteristics

Parameter		Symbol	Min	Typ	Max	Unit
Thermal resistance, Junction-to-Case	TO-220F	R_{thJC}			3.6	ºC /W
	TO-247				0.7	
	TO-263				0.7	
Thermal resistance, Junction-to-Ambient	TO-220F	R_{thJA}			80	ºC /W
	TO-247				62	
	TO-263				62	

Electrical Characteristics

T_J = 25 ºC, unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	BV_{DSS}	V_{GS}=0V, I_D=250uA	600			V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=600V, V_{GS}=0V			10	uA
Gate-Body Leakage Current — Forward	I_{GSSF}	V_{GS}=30V, V_{DS}=0V			100	nA
Gate-Body Leakage Current — Reverse	I_{GSSR}	V_{GS}=-30V, V_{DS}=0V			-1.0	uA
Gate Threshold Voltage	$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=250uA	2.3	3.3	4.3	V
Static Drain-Source On-Resistance	$R_{DS(ON)}$	V_{GS}=10V, I_D=13.0A		126	140	mΩ
Gate Resistance	R_G	f=1MHz, Open Drain		1.7		Ω
Dynamic Characteristics						
Input Capacitance	C_{ISS}	V_{DS}=50V, V_{GS}=0V, f=1MHz		1650		pF
Output Capacitance	C_{OSS}			129.6		
Reverse Transfer Capacitance	C_{RSS}			10.1		
Effective output capacitance, energy related [NOTE5]	$C_{O(er)}$	V_{GS}=0V, V_{DS}=0…480V		76.8		pF
Effective output capacitance, time related [NOTE6]	$C_{O(tr)}$			281		
Turn-on Delay Time	$t_{d(on)}$	V_{DD}=400V, I_D=13.0A R_G=3.4Ω, V_{GS}=10V		11		ns
Rise Time	t_r			10		
Turn-off Delay Time	$t_{d(off)}$			76		
Fall Time	t_f			8		
Gate Charge Characteristics						
Gate to Source Charge	Q_{gs}	V_{DD}=480V, I_D=13.0A V_{GS}=0 to 10V		10.8		nC
Gate to Drain Charge	Q_{gd}			13.9		
Gate Charge Total	Q_g			40.4		
Gate Plateau Voltage	$V_{plateau}$			5.4		V
Reverse Diode Characteristics						
Drain-Source Diode Forward Voltage	V_{SD}	V_{GS}=0V, I_{SD}=13.0A		0.90	1.1	V
Reverse Recovery Time	t_{rr}	V_R=400V, I_F=13.0A dI_F/dt=100.0A/us		124		ns
Reverse Recovery Charge	Q_{rr}			0.59		uC
Peak Reverse Recovery Current	I_{rrm}			9.5		A

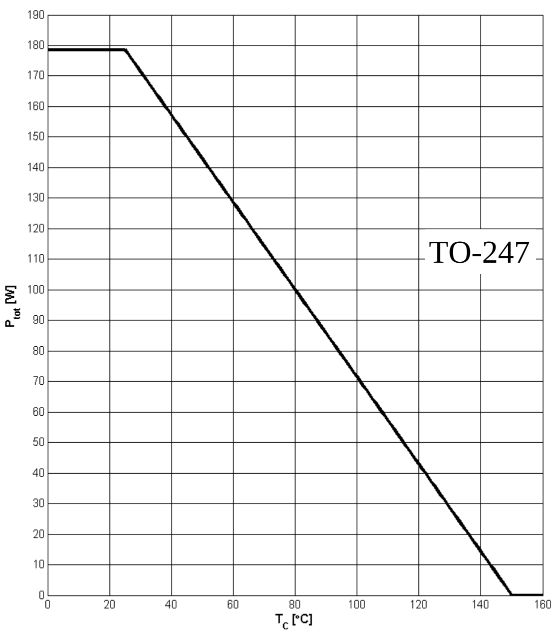
Note:

5. $C_{O(er)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 480V

6. $C_{O(tr)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 480 V

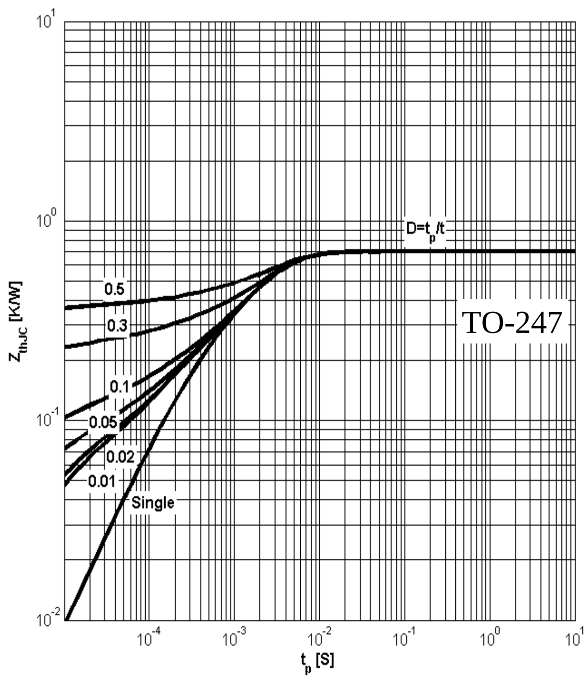
Typical Performance Characteristics

Figure 3: Power Dissipation



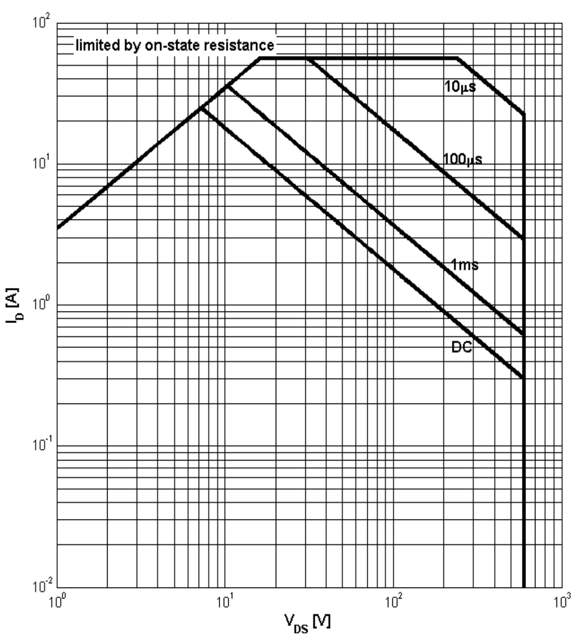
$P_{tot} = f(T_c)$

Figure 4: Max. Transient Thermal Impedance



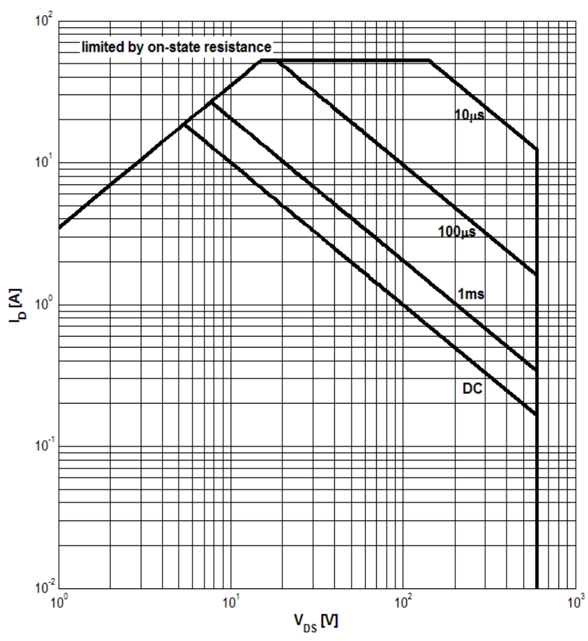
$Z_{(thJC)} = f(t_p)$; parameter: $D = t_p/T$

Figure 5: Safe Operating Area



$I_D = f(V_{DS})$; T_c= 25ºC; V_{GS}>7V; parameter t_p

Figure 6: Safe Operating Area



$I_D = f(V_{DS})$; T_c= 80ºC; V_{GS}>7V; parameter t_p

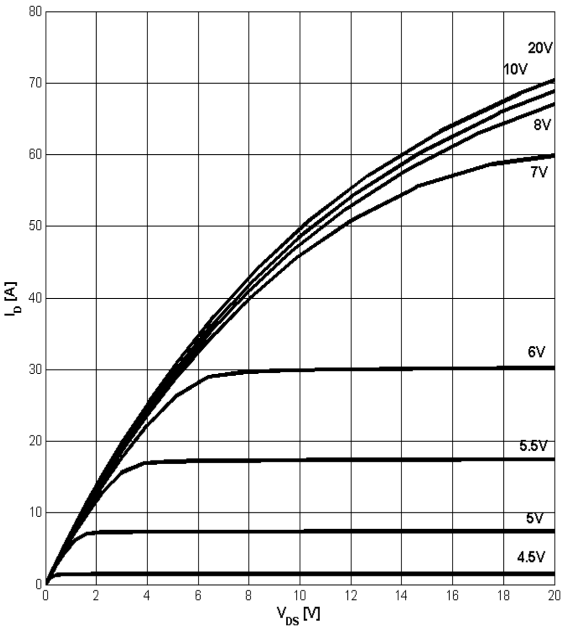
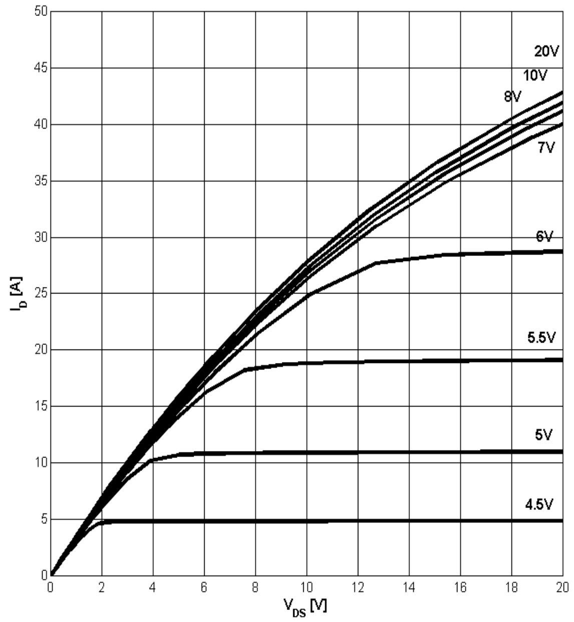
Figure 7: Typ. Output Characteristics	Figure 8: Typ. Output Characteristics
	
$I_D = f(V_{DS})$; Tj= 25ºC; parameter: V_{GS}	$I_D = f(V_{DS})$; T_j= 125ºC; parameter: V_{GS}

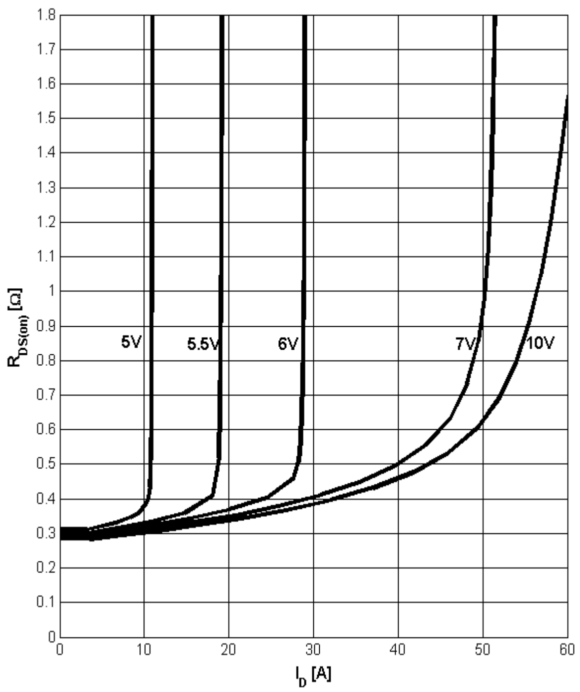
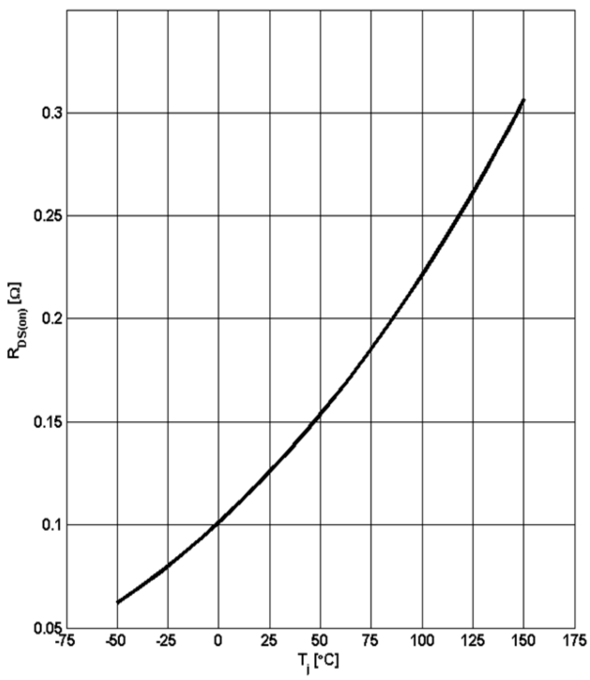
Figure 9: Typ. Drain-Source On-State Resistance	Figure 10: Typ. Drain-Source On-State Resistance
	
$R_{DS(ON)} = f(I_D)$; T_j=125ºC; parameter: V_{GS}	$R_{DS(ON)} = f(T_j)$; I_D=13A; V_{GS}=10V

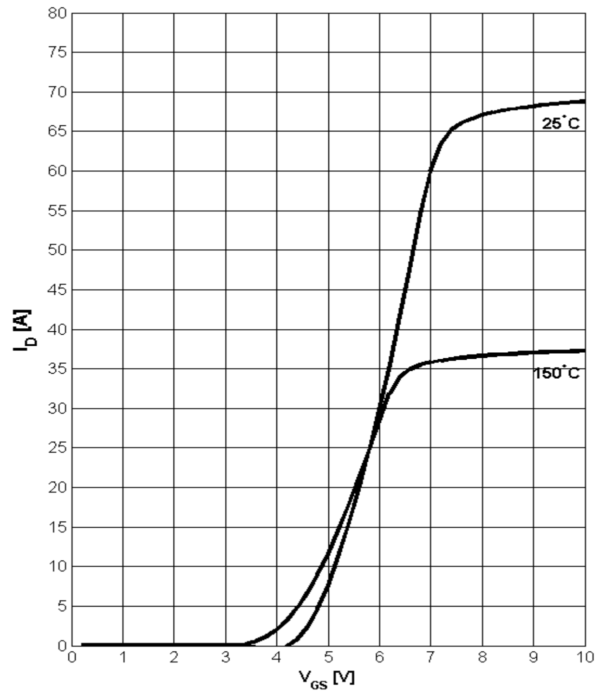
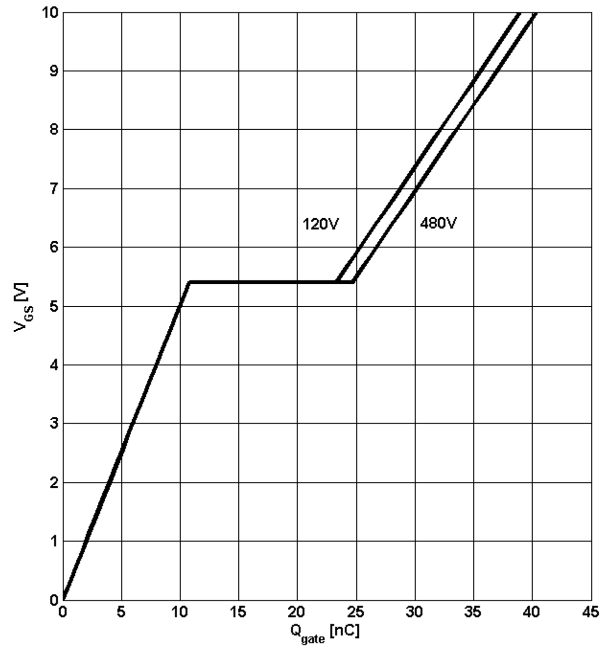
Figure 11: Typ. Transfer Characteristics	Figure 12: Typ. Gate Charge
	
$I_D = f(V_{GS})$; $V_{DS} = 20V$	$V_{GS} = f(Q_{gate})$, $I_D = 13A$ pulsed

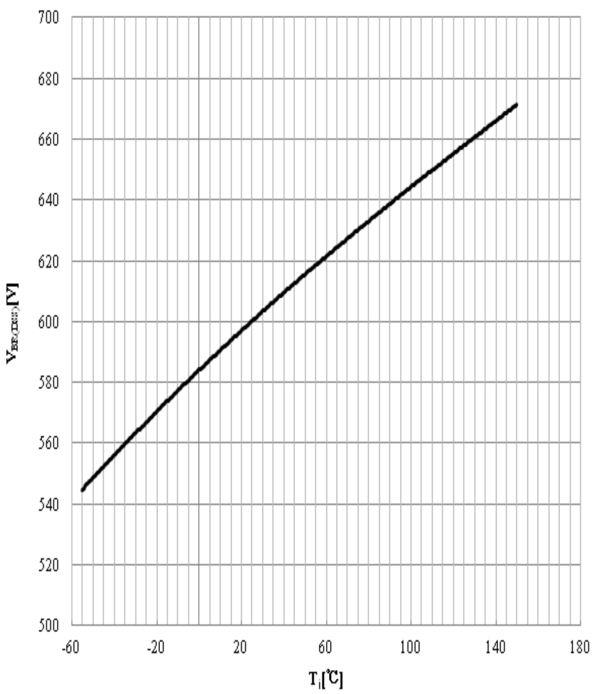
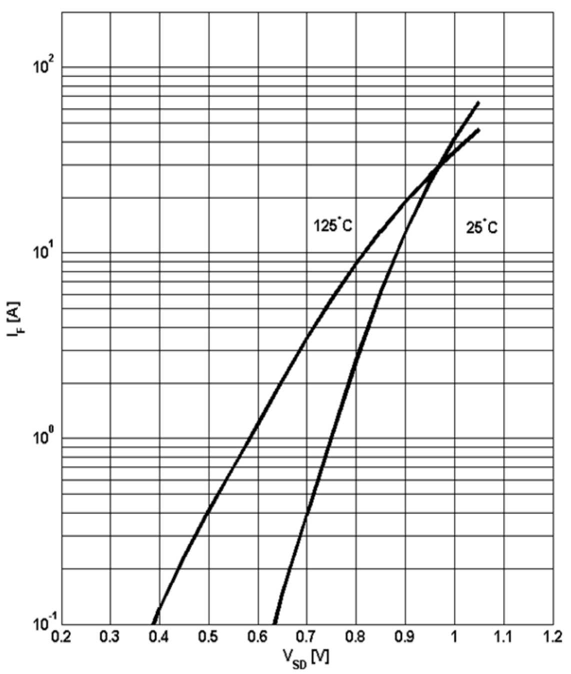
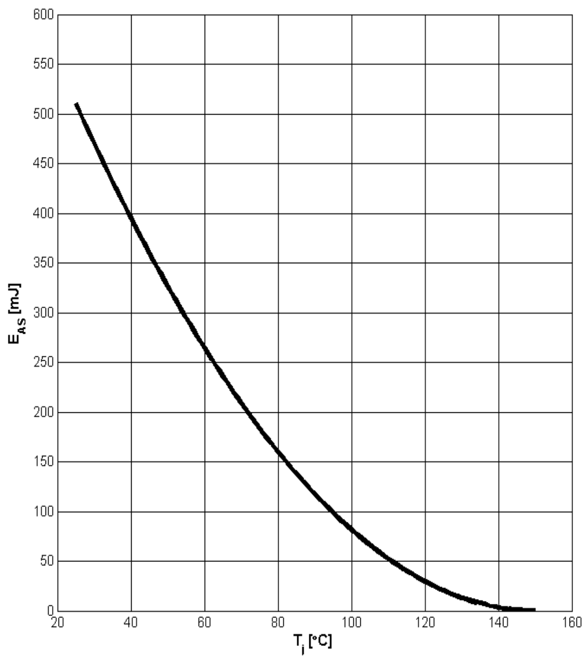
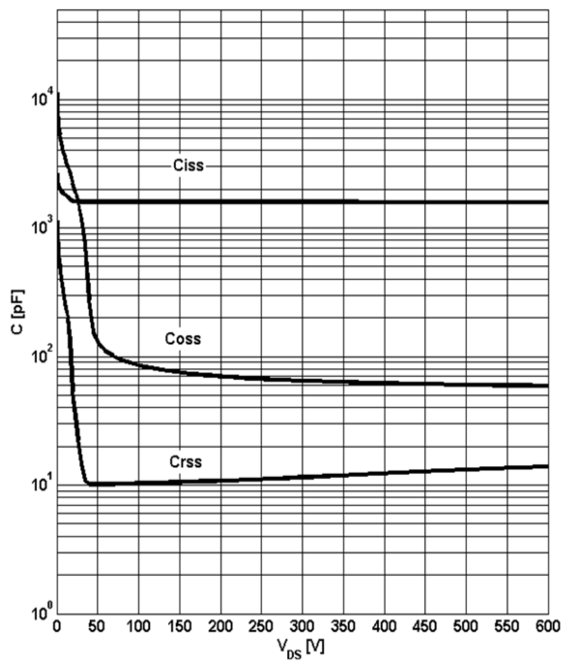
Figure 13: Drain-Source Breakdown Voltage	Figure 14: Forward Characteristics of Reverse Diode
	
$V_{BR(DSS)}=f(T_j)$; $I_D=10mA$	$I_F=f(V_{SD})$; parameter: T_j

Figure 15: Avalanche Energy



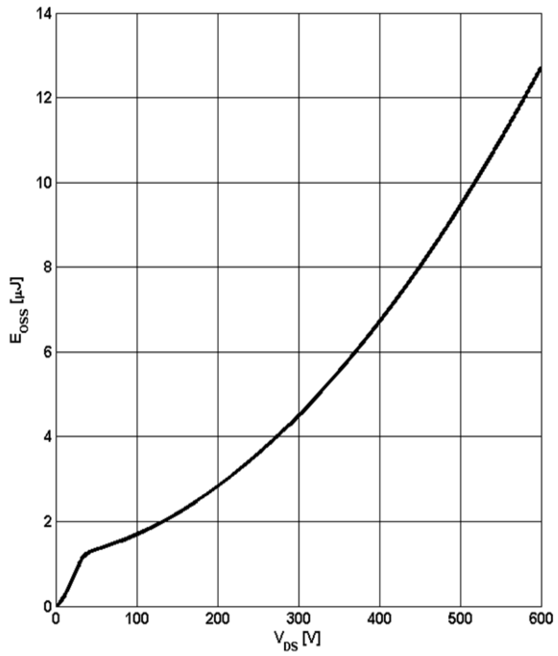
$E_{AS}=f(T_j)$; $I_D=3.6A$; $V_{DD}=60V$

Figure 16: Typ. Capacitances



$C=f(V_{DS})$; $V_{GS}=0$; $f=1MHz$

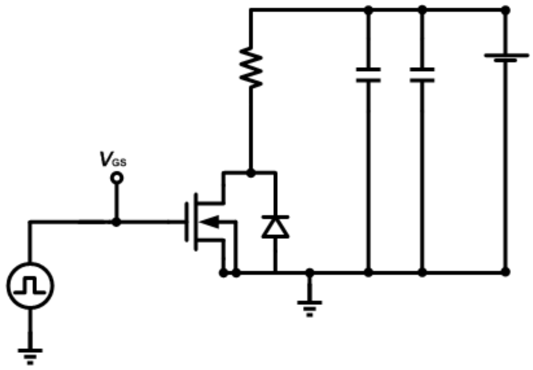
Figure 17: C_{OSS} Stored Energy

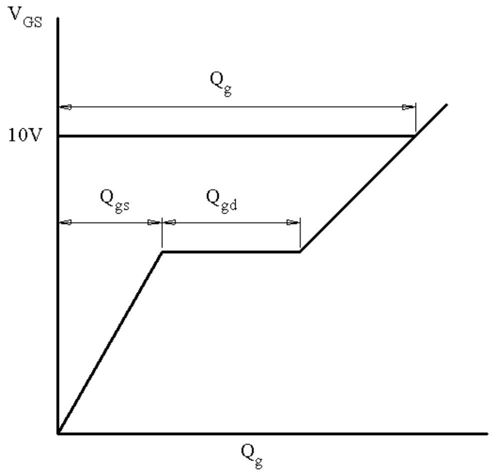


$E_{OSS}=f(V_{DS})$

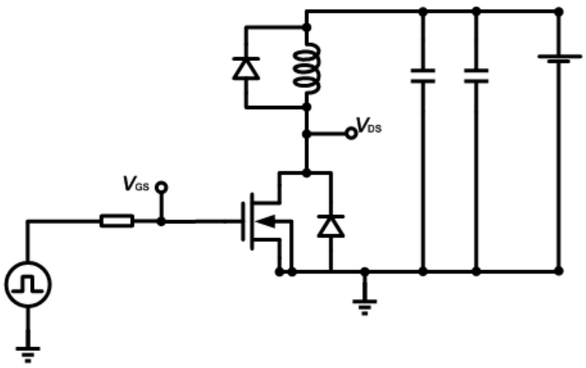
Test Circuits

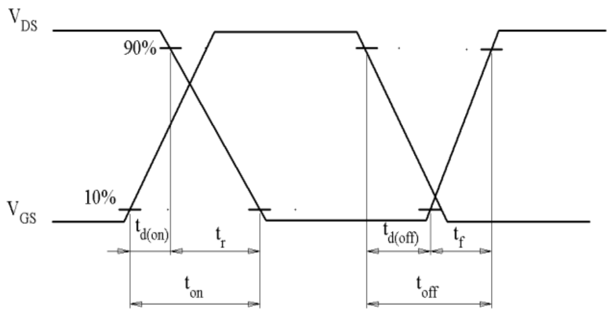
1. Gate Charge Test Circuit & Waveform



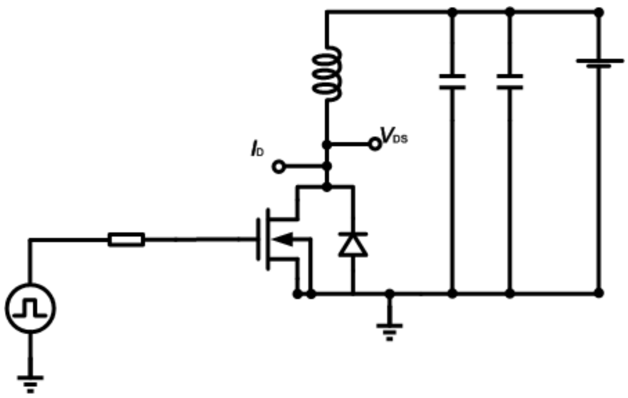


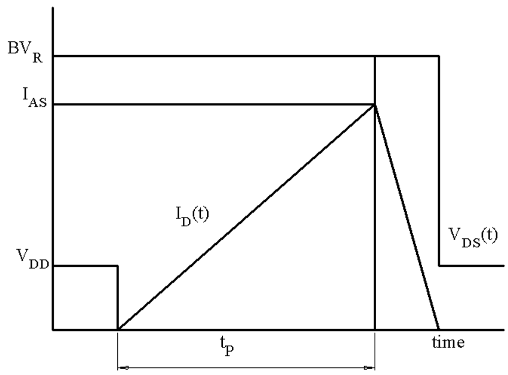
2. Switch Time Test Circuit



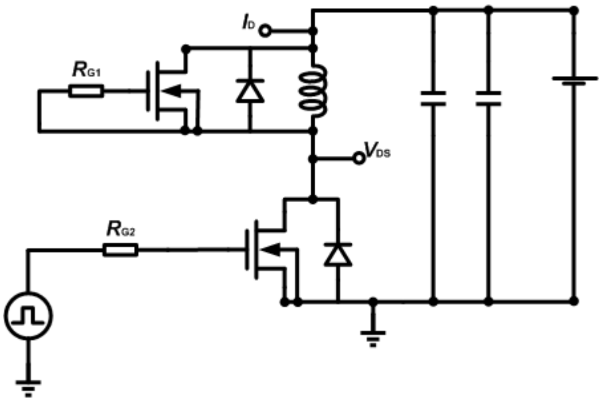


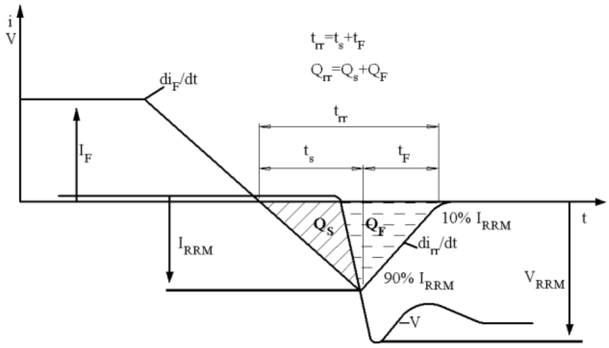
3. Unclaimed Inductive Switching Test Circuit & Waveforms





4. Test Circuit and Waveform for Diode Characteristics

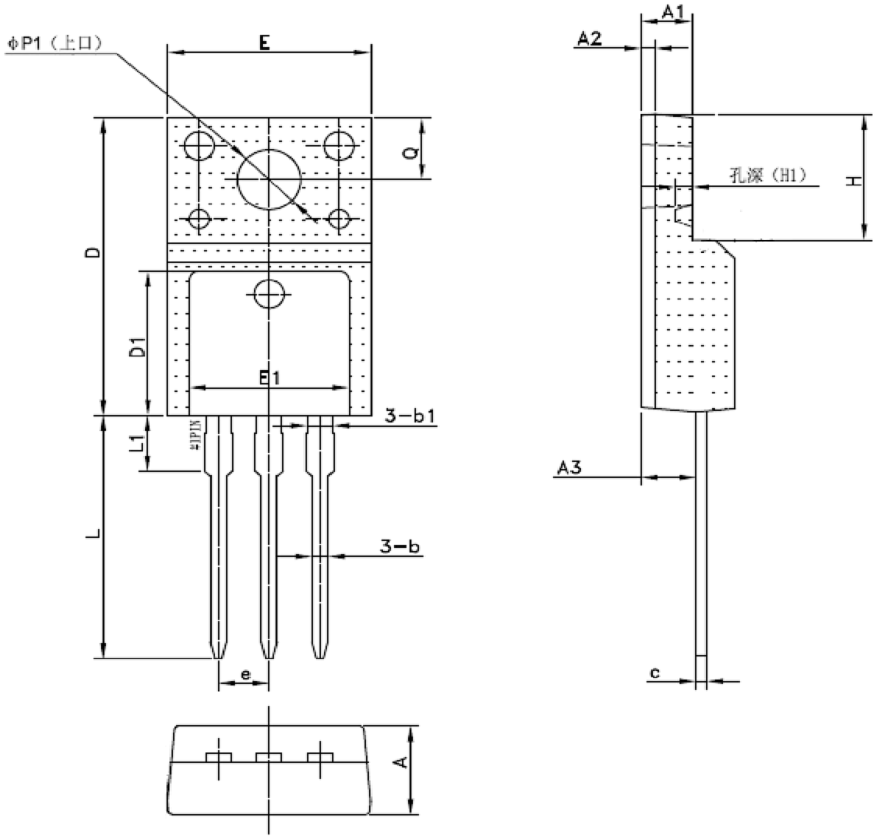




Mechanical Dimensions

TO-220F

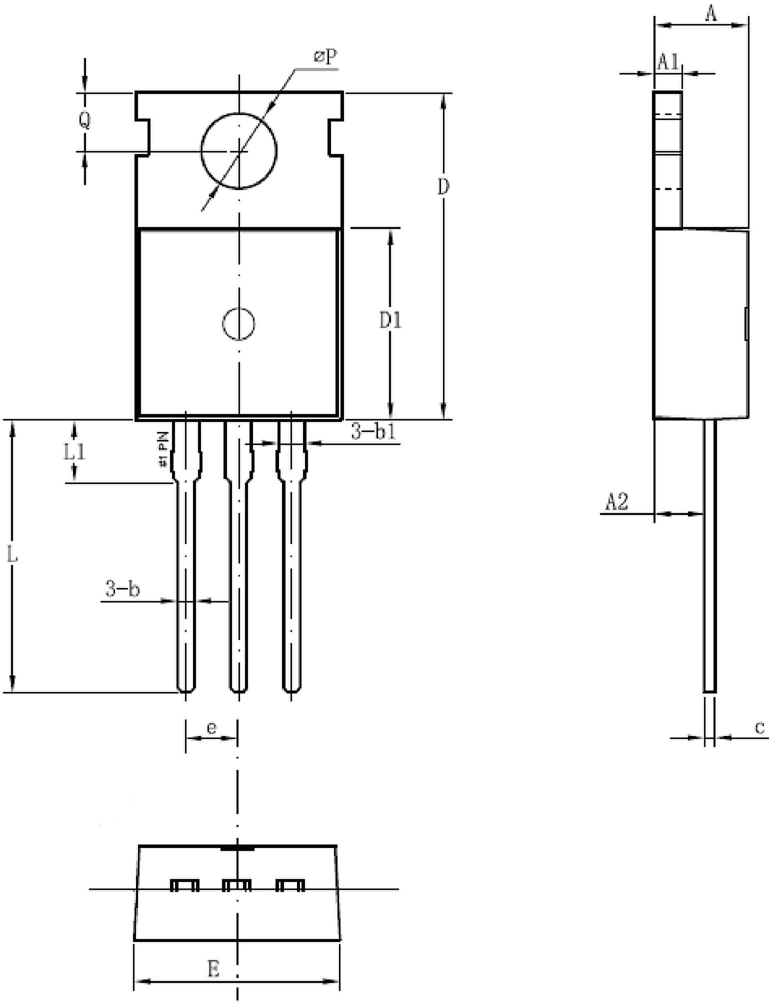
Unit: mm



Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.30	4.70	4.90
A1	2.34	2.54	2.90
A2	-	0.70	-
A3	2.56	2.76	2.96
b	0.55	-	0.95
b1	-	1.28	-
c	0.42	0.50	0.70
D	14.70	-	16.07
D1	-	7.70	-
E	9.96	10.16	10.36
E1	-	8.00	-
e	2.54(BSC)		
H	-	6.70	-
(H1)	-	(0.81)	-
L	12.48	12.98	13.50
L1	-	2.93	-
ΦP1	-	3.18	-
Q	2.90	3.30	3.50

Mechanical Dimensions (Continued)

TO-220C **Unit: mm**

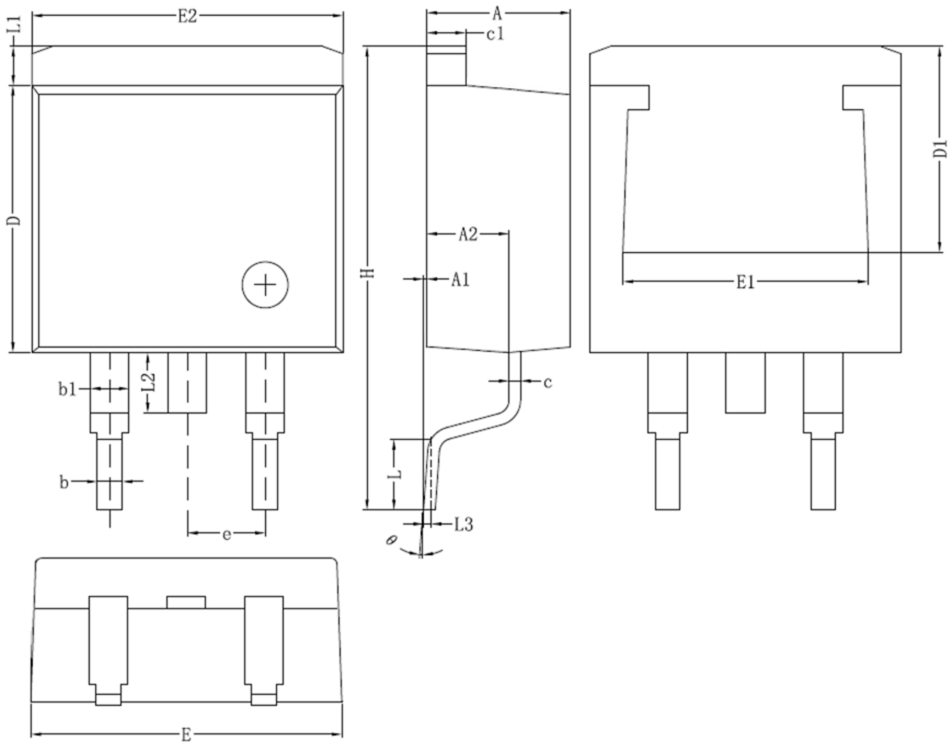


Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.30	4.50	4.70
A1	1.20	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b1	-	1.27	-
c	0.40	0.50	0.65
D	15.20	15.70	16.20
D1	9.00	9.20	9.40
E	9.70	10.00	10.20
e	2.54(BSC)		
L	12.60	13.08	13.60
L1	-	3.00	-
ΦP	3.50	3.60	3.80
Q	2.60	2.80	3.00

Mechanical Dimensions (Continued)

TO-263-2

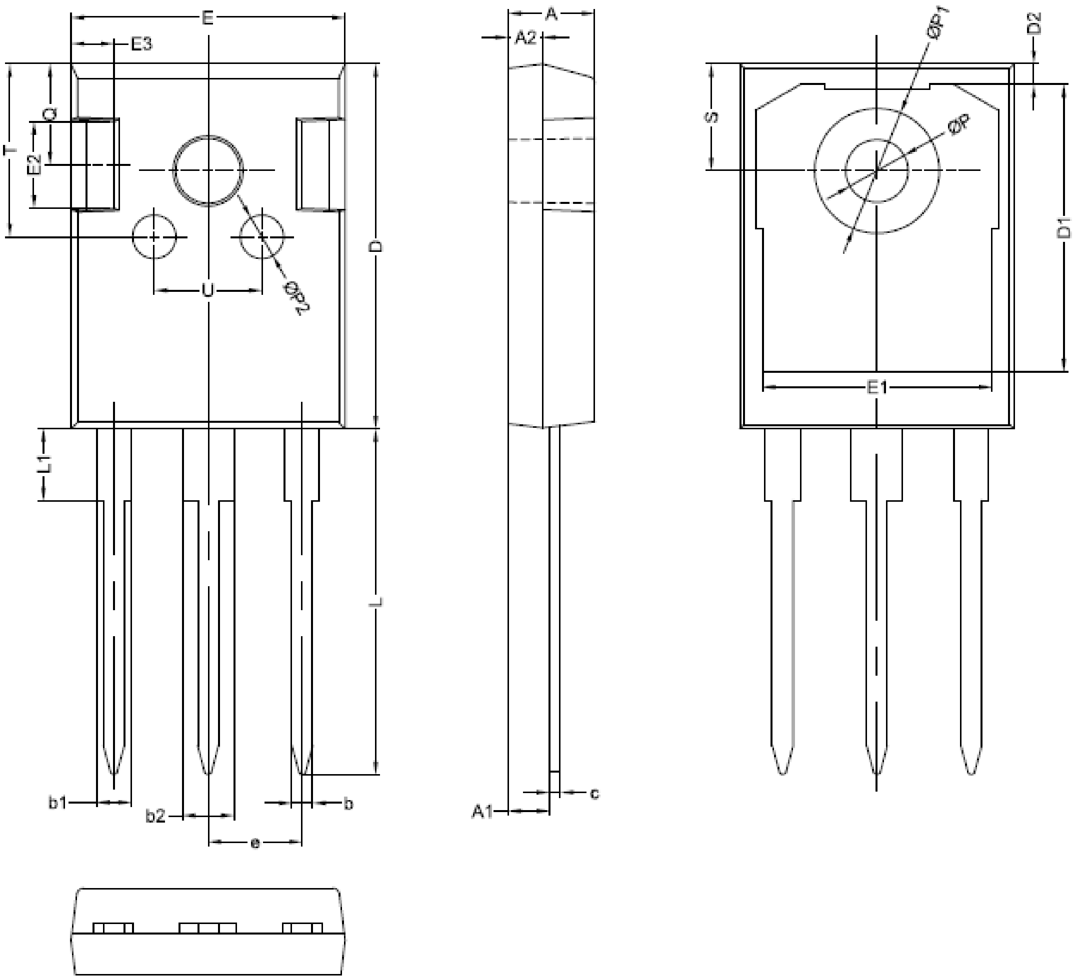
Unit: mm



Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.30	4.60	4.85
A1	0.00	0.10	0.25
A2	2.59	2.69	2.89
b	0.70	0.81	0.96
b1	-	1.27	-
c	0.36	0.40	0.61
c1	1.15	1.27	1.40
D	8.55	-	9.40
D1	6.40	-	-
E	9.80	10.10	10.31
E1	7.60	-	-
E2	9.80	10.00	10.20
e	2.54(BSC)		
H	14.70	15.20	16.00
L	2.00	2.30	2.84
L1	1.00	1.27	1.40
L2	-	-	2.20
L3	-	0.25	-
θ	0°	-	8°

Mechanical Dimensions (Continued)

TO-247 **Unit: mm**



Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.80	5.00	5.20	E2	-	5.00	-
A1	2.21	2.41	2.61	E3	-	2.50	-
A2	1.90	2.00	2.10	e	5.44(BSC)		
b	1.10	1.20	1.35	L	19.42	19.92	20.42
b1	-	2.00	-	L1	-	4.13	-
b2	-	3.00	-	P	3.50	3.60	3.70
c	0.55	0.60	0.75	P1	-	-	7.40
D	20.80	21.00	21.20	P2	-	2.50	-
D1	-	16.55	-	Q	-	5.80	-
D2	-	1.20	-	S	6.05	6.15	6.25
E	15.60	15.80	16.00	T	-	10.00	-
E1	-	13.30	-	U	-	6.20	-