HPC65R390E

390mΩ, 650V, Super Junction N-Channel Power MOSFET

General Description

The HPC65R390E 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 HPC65R390E break down voltage is 650V and it has a high rugged avalanche characteristics. The HPC65R390E is available in TO-252, TO-263-2 and TO-220F packages.

Features

- Ultra Low $R_{DS(ON)}$ = 390mΩ @ V_{GS} = 10V.
- Ultra Low Gate Charge, Qg=22.3nC typ.
- Fast switching capability
- Robust design with better EAS performance
- EMI Improved Design ***(SnowMOS™ Gen.2)***

Application

- TV Power
- High Performance Charger / Adapter
- LED Lighting Power

Symbol

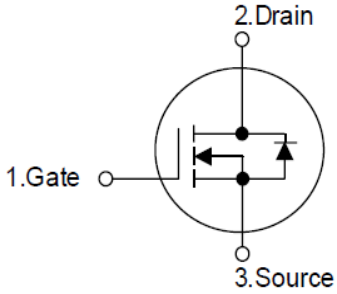


Figure 1 Symbol of HPC65R390E

Package Type

TO-252

TO-263-2

TO-220F

Figure 2 Package Types of HPC65R390E

Ordering Information

HPC65R390E□□–□

Circuit Type

Package
D: TO-252
S2: TO-263-2
TF: TO-220F

E: Lead Free
G: Green
Blank: Tube
TR: Tape & Reel

Package	Part Number		Marking ID		Packing Type
	Lead Free	Green	Lead Free	Green	
TO-252	HPC65R390EDTR-E	HPC65R390EDTR-G	HPC65R390EDE	HPC65R390EDG	Tape & Reel
TO-263-2	HPC65R390ES2TR-E	HPC65R390ES2TR-G	HPC65R390ES2E	HPC65R390ES2G	Tape & Reel
TO-220F	HPC65R390ETF-E	HPC65R390ETF-G	HPC65R390ETFE	HPC65R390ETFG	Tube

Absolute Maximum Ratings

Parameter		Symbol	Rating	Unit
Drain-Source Voltage		V_{DSS}	650	V
Gate-Source Voltage		V_{GSS}	±30	V
Continuous Drain Current	T_C=25ºC	I_D	9.2	A
	T_C=125ºC		4.1	
Pulsed Drain Current (Note 2)		I_{DM}	28.5	A
Avalanche Energy, Single Pulse (Note 3)		E_{AS}	118	mJ
Avalanche Energy, Repetitive (Note 2)		E_{AR}	0.15	mJ
Avalanche Current, Repetitive (Note 2)		I_{AR}	1.5	A
Continuous Diode Forward Current		I_S	9.2	A
Diode Pulse Current		$I_{S.PULSE}$	28.5	A
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} = 1.5A, V_{DD} = 60V, R_G = 25Ω, Starting T_J = 25°C

Electrical Characteristics

T_J = 25℃, unless otherwise specified.

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Statistic Characteristics							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D=250uA	650			V
Zero Gate Voltage Drain Current		I_{DSS}	V_{DS}=650V, V_{GS}=0V			1	uA
Gate-Body Leakage Current	Forward	I_{GSSF}	V_{GS}=30V, V_{DS}=0V			100	nA
	Reverse	I_{GSSR}	V_{GS}=-30V, V_{DS}=0V			-100	
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=250uA	2.7	3.6	4.5	V
Static Drain-Source On-Resistance		$R_{DS(ON)}$	V_{GS}=10V, I_D=4.5A		335	390	mΩ
Gate Resistance		R_G	f=1MHz, Open Drain		8.5		Ω
Dynamic Characteristics							
Input Capacitance		C_{ISS}	V_{DS}=50V, V_{GS}=0V, f=1MHz		427		pF
Output Capacitance		C_{OSS}			41.4		
Reverse Transfer Capacitance		C_{RSS}			24.2		
Effective output capacitance, energy related NOTE5		$C_{O(er)}$	V_{GS}=0V, V_{DS}=0…480V		19.4		pF
Effective output capacitance, time related NOTE6		$C_{O(tr)}$			89.2		
Turn-on Delay Time		$t_{d(on)}$	V_{DD}=400V, I_D=4.5A R_G=10Ω, V_{GS}=10V		11		ns
Rise Time		t_r			13		
Turn-off Delay Time		$t_{d(off)}$			41		
Fall Time		t_f			15		
Gate Charge Characteristics							
Gate to Source Charge		Q_{gs}	V_{DD}=480V, I_D=4.5A V_{GS}=0 to 10V		5.1		nC
Gate to Drain Charge		Q_{gd}			11.2		
Gate Charge Total		Q_g			22.3		
Gate Plateau Voltage		$V_{plateau}$			5.9		V
Reverse Diode Characteristics							
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS}=0V, I_{SD}=4.5A		0.84	1.1	V
Reverse Recovery Time		t_{rr}	V_R=400V, I_F=4.5A dI$_F$/dt=100A/us		220		ns
Reverse Recovery Charge		Q_{rr}			1.86		uC
Peak Reverse Recovery Current		I_{rrm}			16.9		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

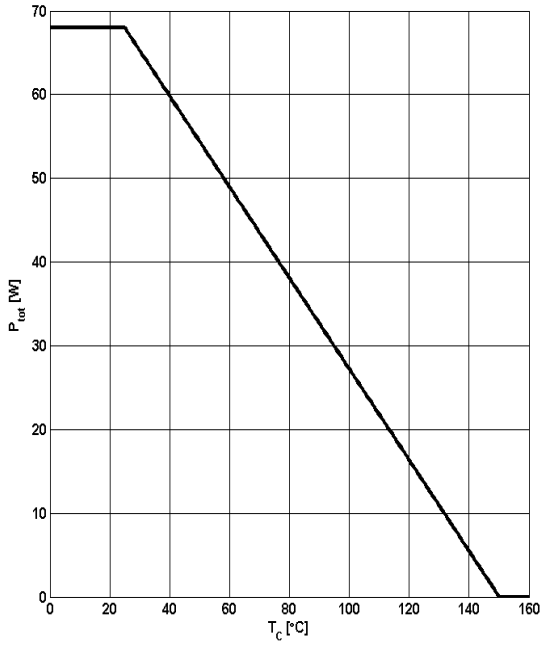
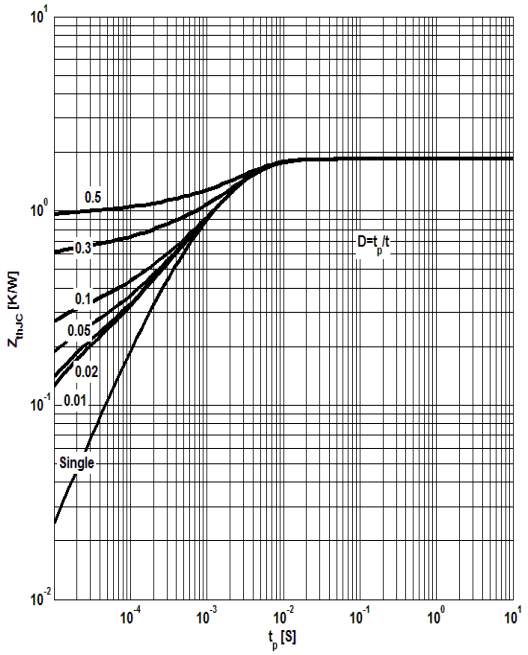
Figure 3: Power Dissipation	Figure 4: Max. Transient Thermal Impedance
	
$P_{tot} = f(T_C)$	$Z_{(thJC)} = f(t_p)$; parameter: $D = t_p/T$

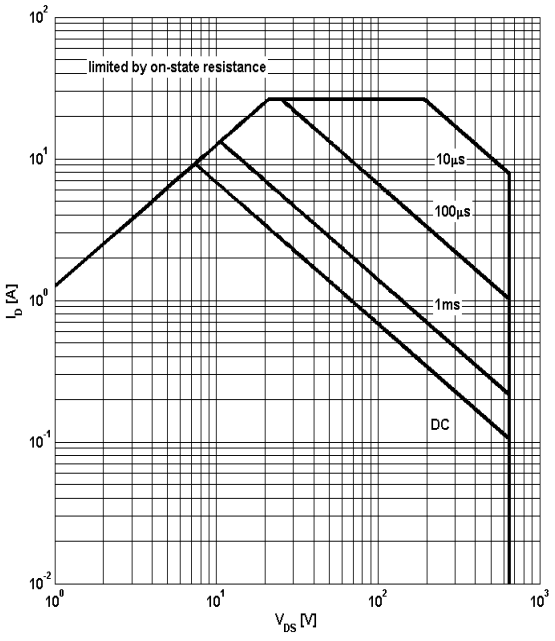
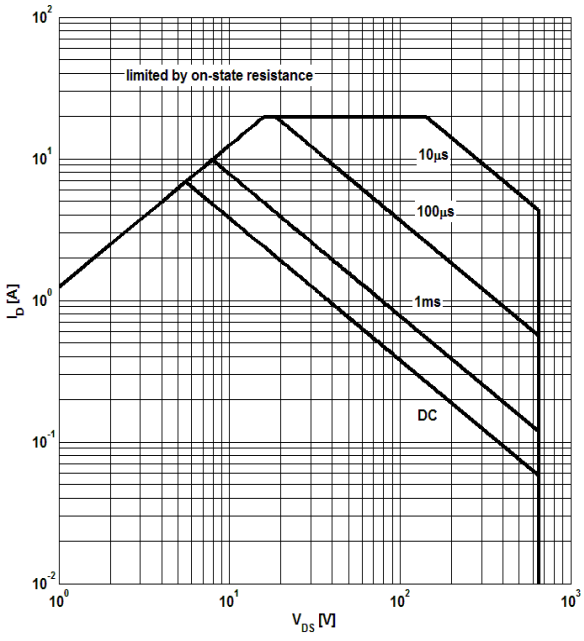
Figure 5: Safe Operating Area	Figure 6: Safe Operating Area
	
$I_D = f(V_{DS})$; T_c= 25ºC; V_{GS}>7V; parameter t_p	$I_D = f(V_{DS})$; T_c= 80ºC; V_{GS}>7V; parameter t_p

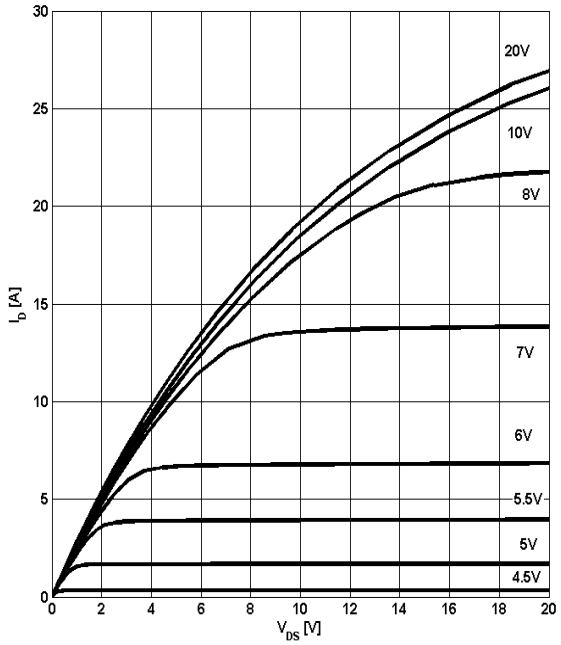
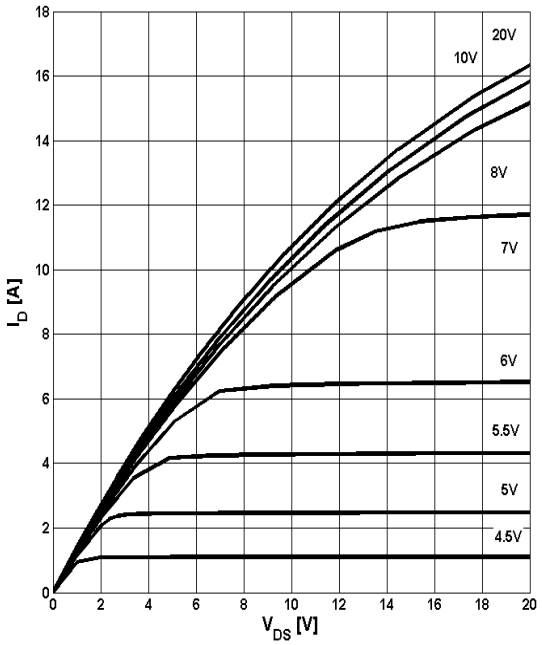
Figure 7: Typ. Output Characteristics	Figure 8: Typ. Output Characteristics
	
$I_D = f(V_{DS})$; Tj= 25ºC; parameter: V_{GS}	$I_D = f(V_{DS})$; T_j= 125ºC; parameter: V_{GS}

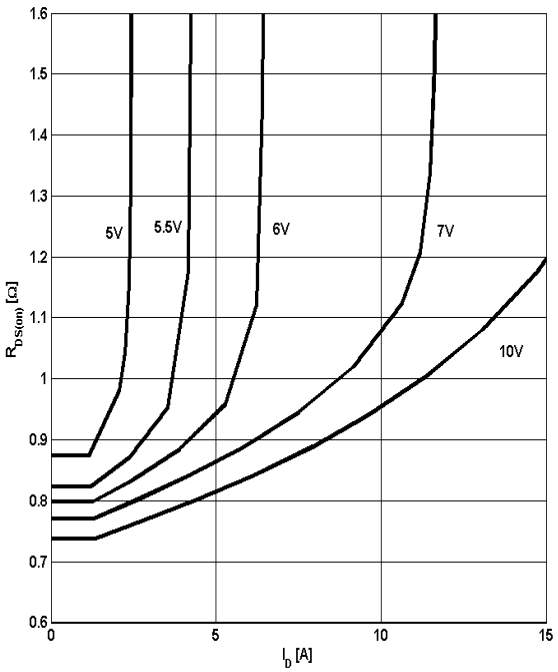
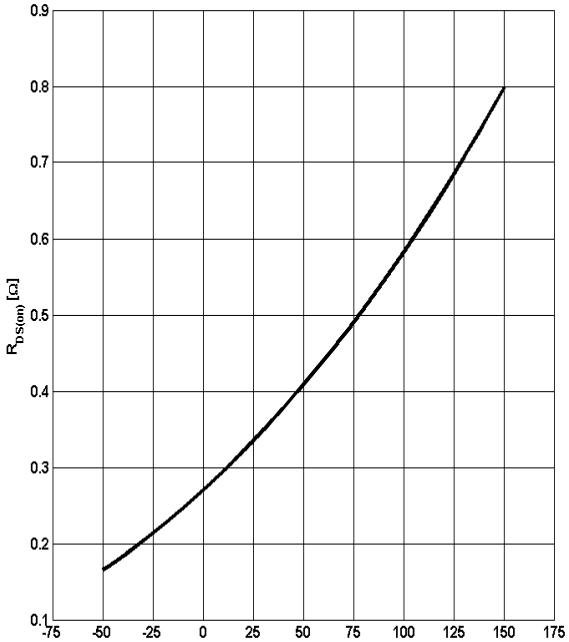
Figure 9: Typ. Drain-Source On-State Resistance	Figure 10: Typ. Drain-Source On-State Resistance
	
$R_{DS(ON)} = f(I_D)$; T_j=125ºC; parameter: V_{GS}	$R_{DS(ON)} = f(T_j)$; I_D=4.5A; V_{GS}=10V

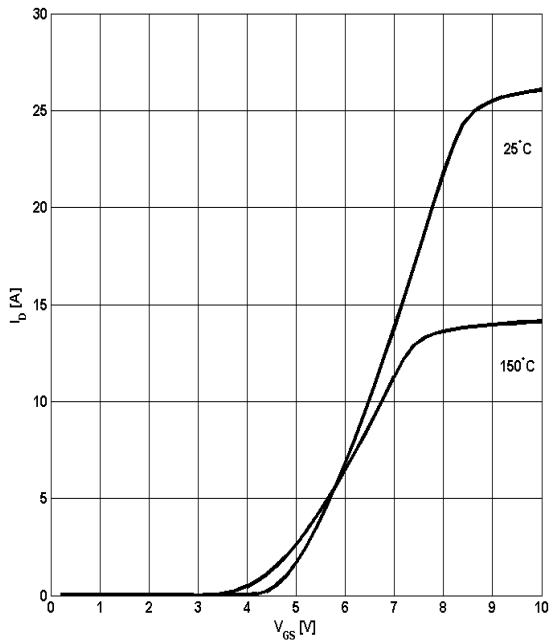
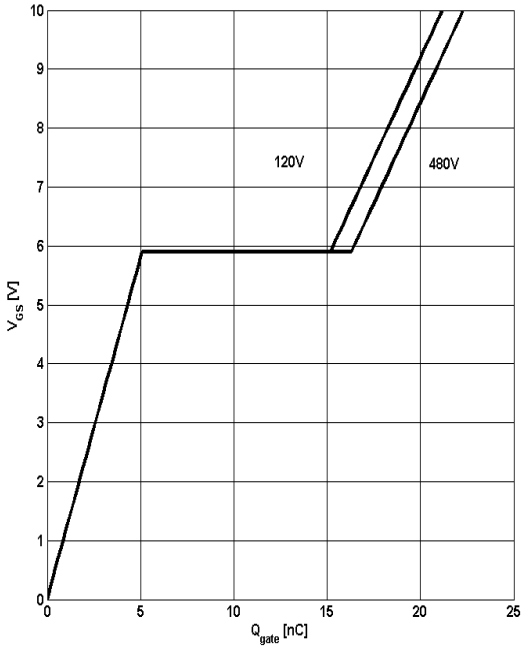
Figure 11: Typ. Transfer Characteristics	Figure 12: Typ. Gate Charge
	
$I_D = f(V_{GS})$; $V_{DS} = 20V$	$V_{GS} = f(Q_{gate})$, I_D=4.5A pulsed

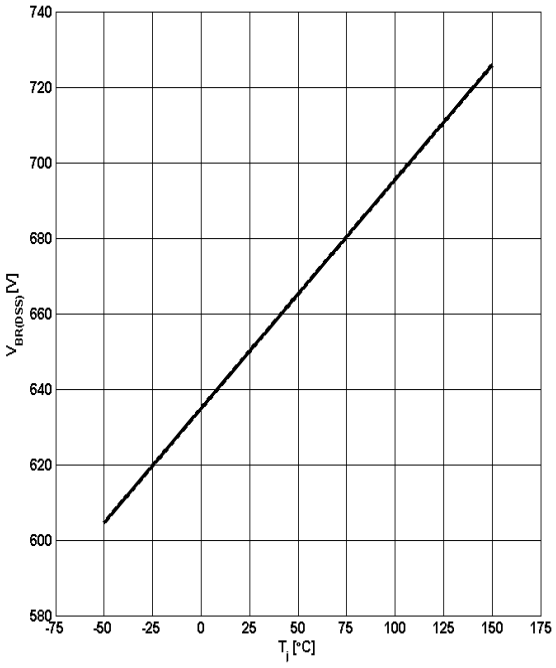
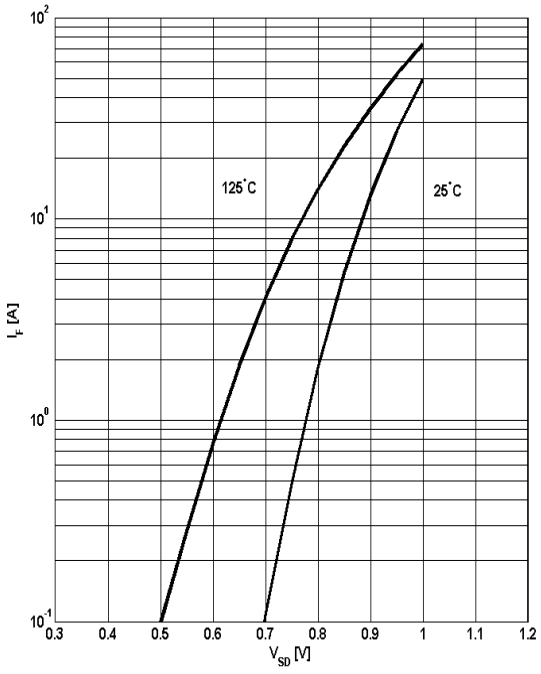
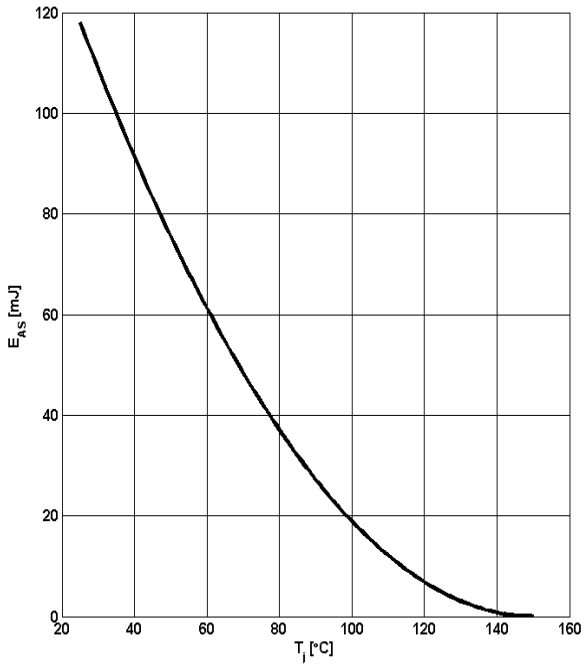
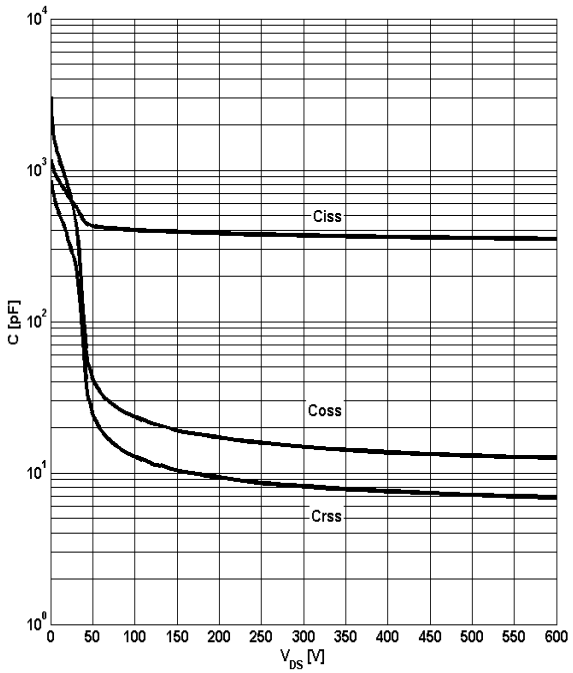
Figure 13: Drain-Source Breakdown Voltage	Figure 14: Forward Characteristics of Reverse Diode
	
$V_{BR(DSS)}=f(T_j)$; I_D=1mA	$I_F=f(V_{SD})$; parameter: T_j

Figure 15: Avalanche Energy



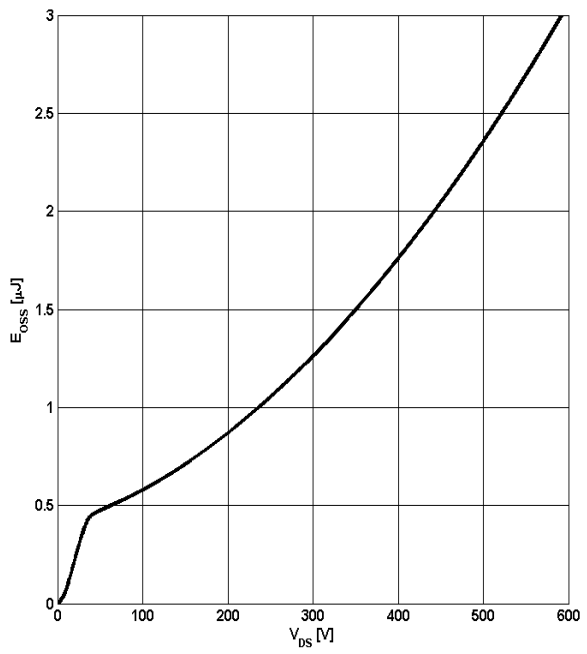
$E_{AS}=f(T_j)$; $I_D=1.5A$; $V_{DD}=60V$

Figure 16: Typ. Capacitances



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

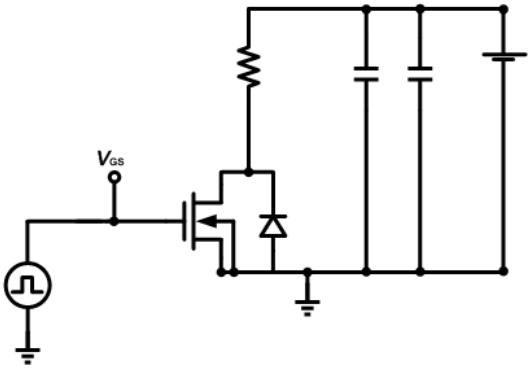
Figure 17: C_{OSS} Stored Energy

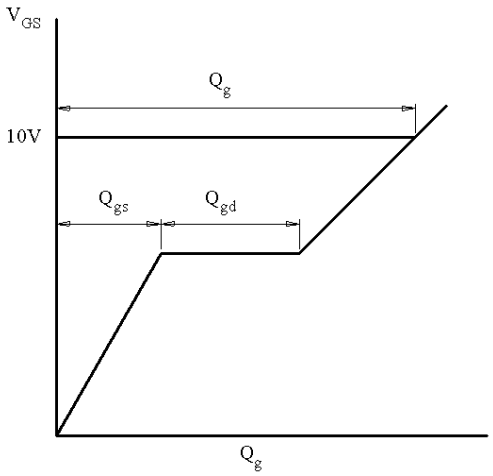


$E_{OSS}=f(V_{DS})$

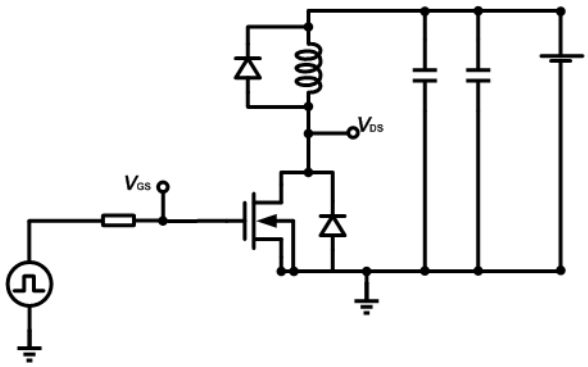
Test Circuits

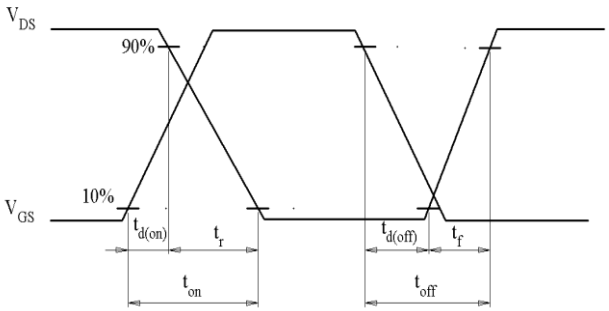
1. Gate Charge Test Circuit & Waveform



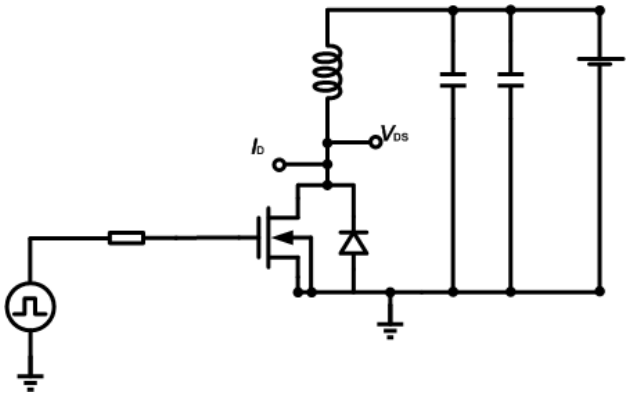


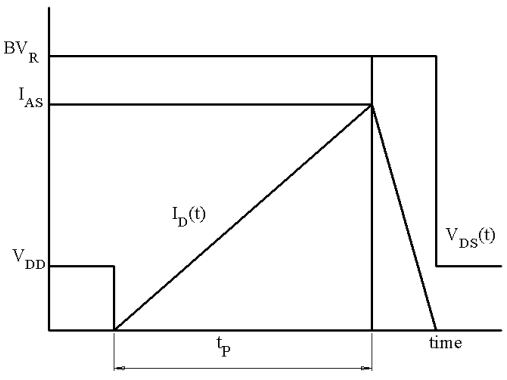
2. Switch Time Test Circuit



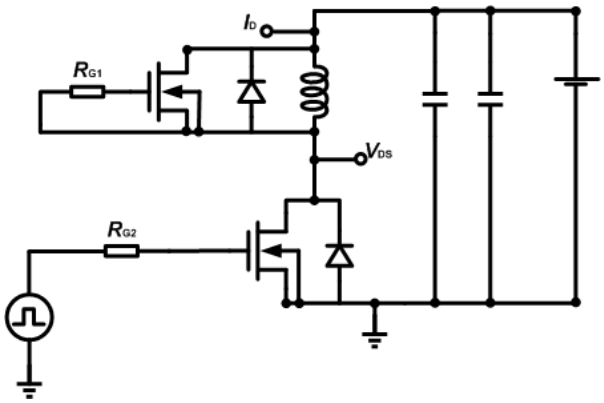


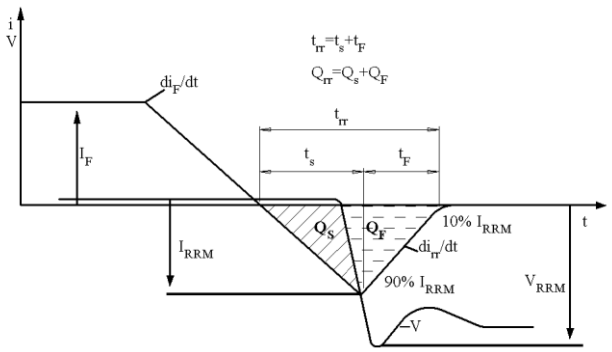
3. Unclaimed Inductive Switching Test Circuit & Waveforms





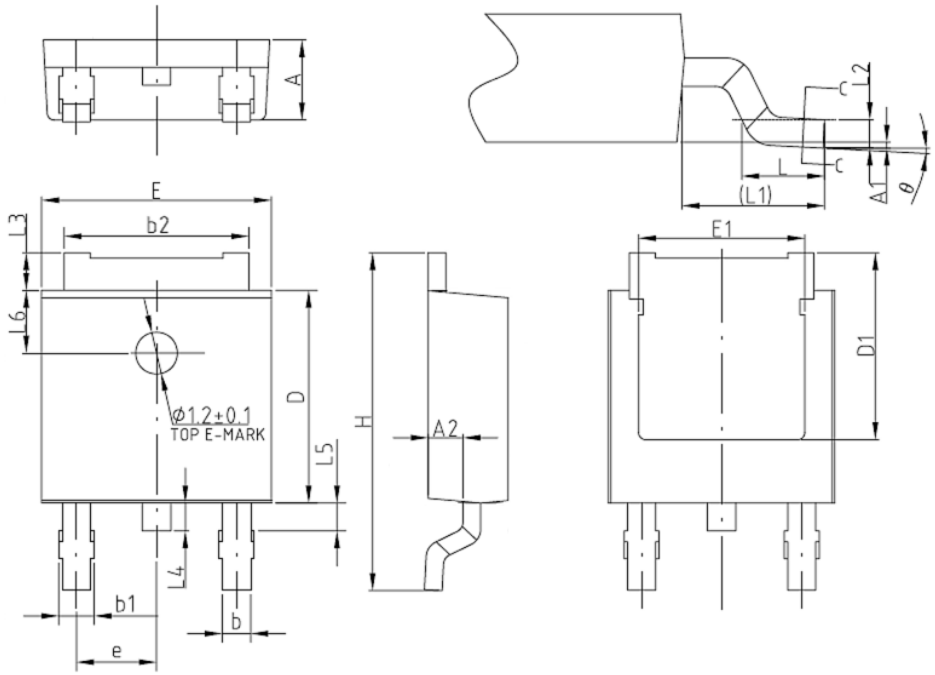
4. Test Circuit and Waveform for Diode Characteristics





Mechanical Dimensions

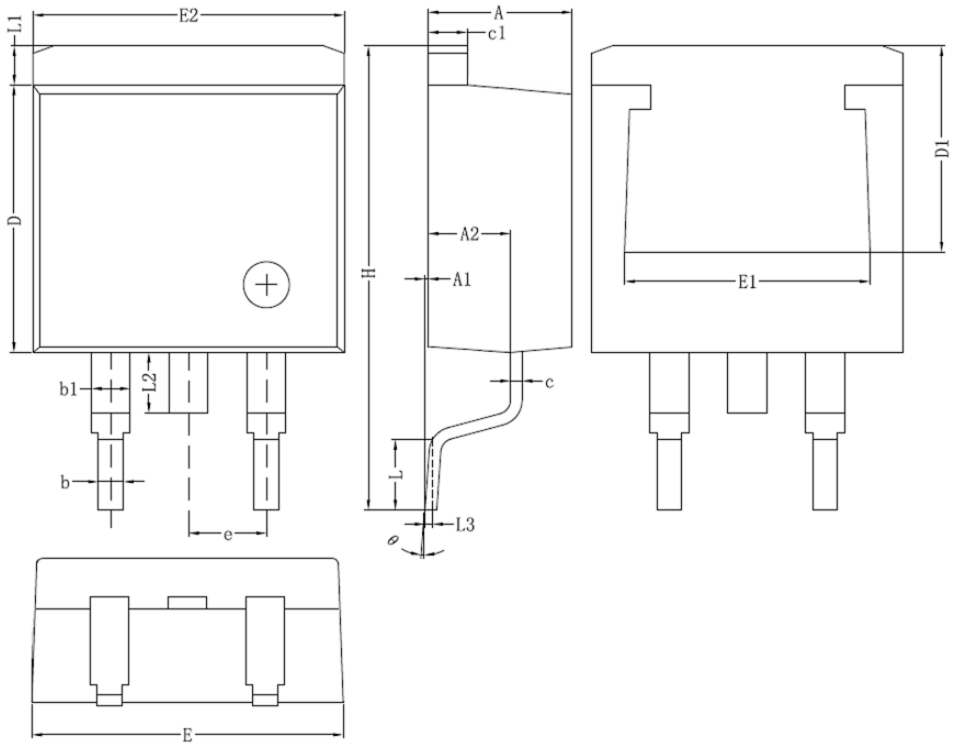
TO-252 **Unit: mm**



Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	2.20	2.30	2.40
A1	0	-	0.10
A2	0.90	1.00	1.17
b	0.70	0.76	0.90
b1	0.77	-	1.10
b2	5.13	5.33	5.46
c	0.45	-	0.60
D	5.95	6.10	6.25
D1	-	5.30	-
E	6.45	6.60	6.75
E1	-	4.80	-
e	2.286(BSC)		
H	9.70	10.10	10.40
L	1.25	1.50	1.75
L1	-	2.90	-
L2	-	0.51	-
L3	0.90	-	1.25
L4	-	0.80	-
L5	-	1.00	-
L6	-	1.80	-
θ	0°	-	8°

Mechanical Dimensions (Continued)

TO-263-2 **Unit: mm**

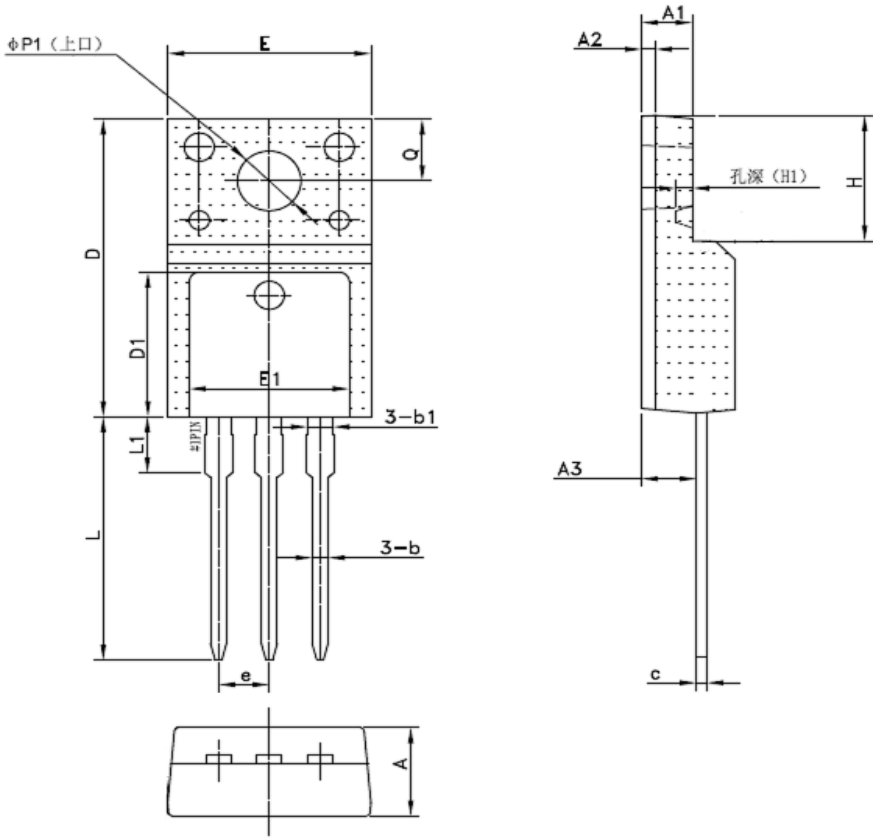


Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	4.30	4.60	4.85
A1	0.00	0.10	0.25
A2	2.59	2.69	2.89
b	0.70	0.81	0.96
b1	-	1.27	-
c	0.36	0.40	0.61
c1	1.15	1.27	1.40
D	8.55	-	9.40
D1	6.40	-	-
E	9.80	10.10	10.31
E1	7.60	-	-
E2	9.80	10.00	10.20
e	2.54(BSC)		
H	14.70	15.20	16.00
L	2.00	2.30	2.84
L1	1.00	1.27	1.40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

Mechanical Dimensions (Continued)

TO-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