



**Maximum Ratings**  $T_j = 25$  unless otherwise specified

Parameter	Symbol	Value	Unit
Collector-Emitter Breakdown Voltage	$V_{CE}$	650	V
DC collector current, limited by $T_{jmax}$ $T_C = 25^\circ C$ $T_C = 100^\circ C$	$I_C$	40 20	A
Diode Forward current, limited by $T_{jmax}$ $T_C = 25^\circ C$ $T_C = 100^\circ C$	$I_F$	40 20	A
Continuous Gate-emitter voltage	$V_{GE}$	$\pm 20$	V
Transient Gate-emitter voltage	$V_{GE}$	$\pm 30$	V
Turn off safe operating area $V_{CE} = 650V$ , $T_j = 150^\circ C$	-	80	A
Pulsed collector current, $V_{GE} = 15V$ , $t_p$ limited by $T_{jmax}$	$I_{CM}$	80	A
Short Circuit Withstand Time, $V_{GE} = 15V$ , $V_{CE} = 400V$	$T_{sc}$	5	$\mu s$
TO-220F Power dissipation, $T_j = 25$	$P_{tot}$	27	W
TO-220, TO-263, Power dissipation, $T_j = 25$	$P_{tot}$	105	W
Operating junction temperature	$T_j$	-40...+150	$^\circ C$
Storage temperature	$T_s$	-55...+150	$^\circ C$
Soldering temperature, wave soldering 1.6mm (0.063in.) from case for 10s	-	260	$^\circ C$

**Thermal Resistance**

Parameter	Symbol	TO-220, TO-263	TO-220F	Unit
IGBT thermal resistance, junction - case	R (j-c)	1.2	4.9	K/W
Diode thermal resistance, junction - case	R (j-c)	2.38	5.8	K/W
Thermal resistance, junction - ambient	R (j-a)	62.5		K/W

**Electrical Characteristics of the IGBT**  $T_j = 25$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Static Characteristics</b> (Tested on wafers)						
$BV_{CES}$	Collector to Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	650	-	-	V
$V_{CE(SAT)}$	Collector to Emitter Saturation Voltage	$I_C = 20A, V_{GE} = 15V$	-	1.9	2.2	V
$V_{GE(th)}$	G-E Threshold Voltage	$V_{GE} = V_{CE}, I_C = 250\mu A$	4.1	5.0	5.7	V
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = 650V, V_{GE} = 0V$	-	-	25	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = \pm 20V, V_{CE} = 0V$	-	-	$\pm 200$	nA
$g_{fs}$	Transconductance	$V_{CE}=20V, I_C=15A$	-	10	-	S

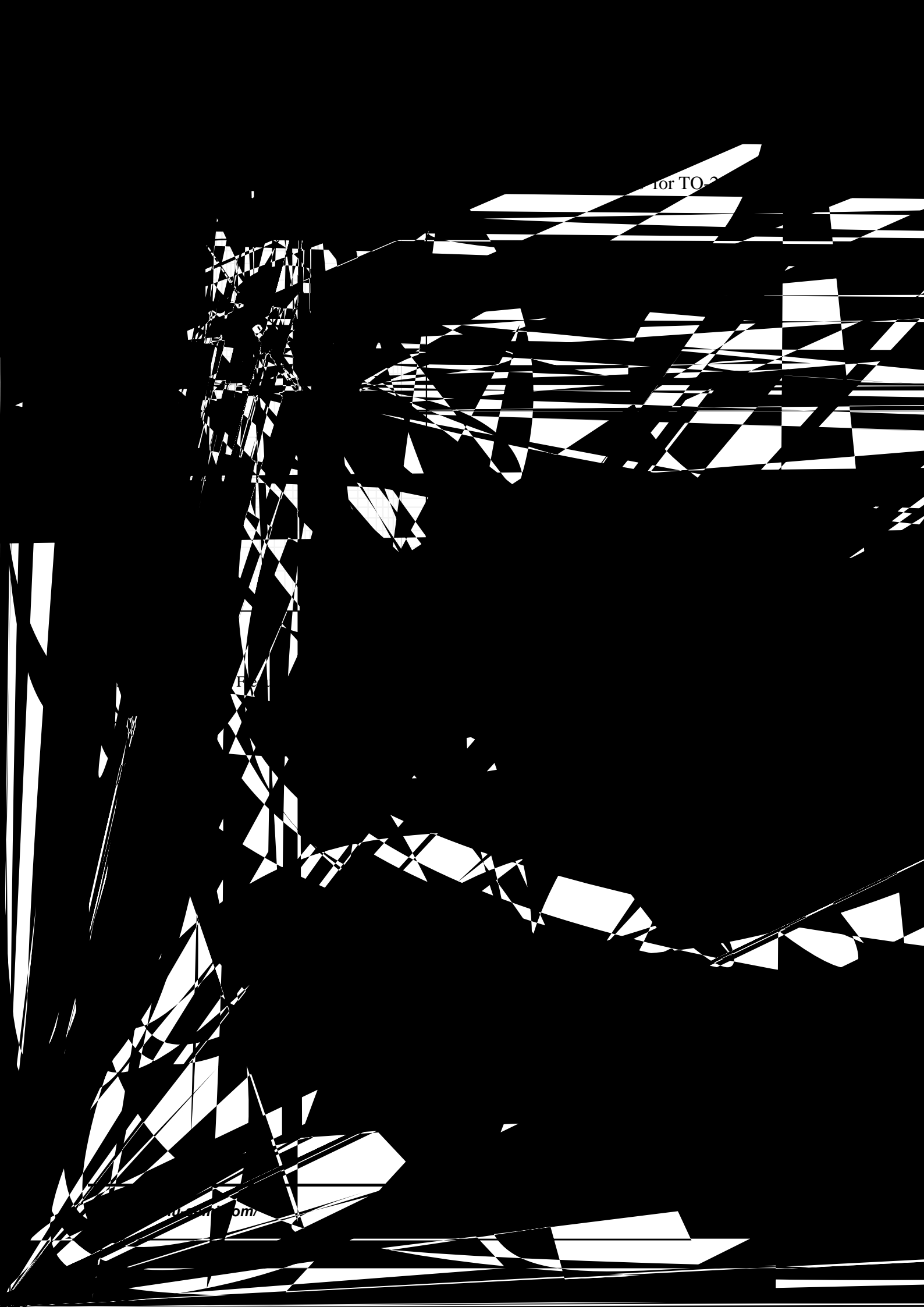
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>Dynamic</b>						
Input capacitance	$C_{ies}$	$V_{CE} = 25V, V_{GE} = 0V,$ $f = 1MHz$	-	990	-	pF
Output capacitance	$C_{oes}$		-	56	-	
Reverse transfer capacitance	$C_{res}$		-	30	-	
Gate charge	$Q_G$	$V_{CC} = 480V, I_C = 20A,$ $V_{GE} = 15V$	-	52	-	nC
Short circuit collector current	$I_{C\ SC}$	$V_{GE}=15V, t_{SC} \leq 5\mu s$ $V_{CC}=400V,$ $T_{j, start}=25^\circ C$	-	98	-	A

**Switching Characteristic, Inductive Load**  $T_j = 25$  unless otherwise specified

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>Dynamic</b>						
Turn-on Delay Time	$t_{d(on)}$	$T_j = 25^\circ\text{C}$ $V_{CC} = 400\text{V},$ $I_C = 20\text{A},$ $V_{GE} = 0/15\text{V},$ $R_g = 12\Omega$	-	13	-	ns
Rise Time	$t_r$		-	20	-	ns
Turn-off Delay Time	$t_{d(off)}$		-	60	-	ns
Fall Time	$t_f$		-	40	-	ns
Turn-on Energy	$E_{on}$		-	1.0	-	mJ
Turn-off Energy	$E_{off}$		-	0.2	-	mJ

**Electrical Characteristics of the DIODE**  $T_j = 25$  unless otherwise specified

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
<b>Dynamic</b>						
Diode Forward Voltage	$V_{FM}$	$I_F = 20\text{A}$	-	1.9	-	V



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Fig. 5 Output characteristics

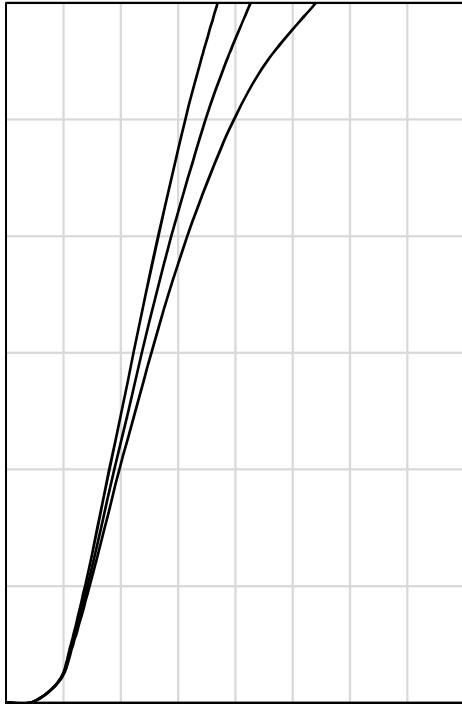


Fig. 6 Saturation voltage characteristics

Fig. 7 Switching times vs. gate resistor

Fig. 8 Switching times vs. collector current

Fig. 9 Switching loss vs. gate resistor

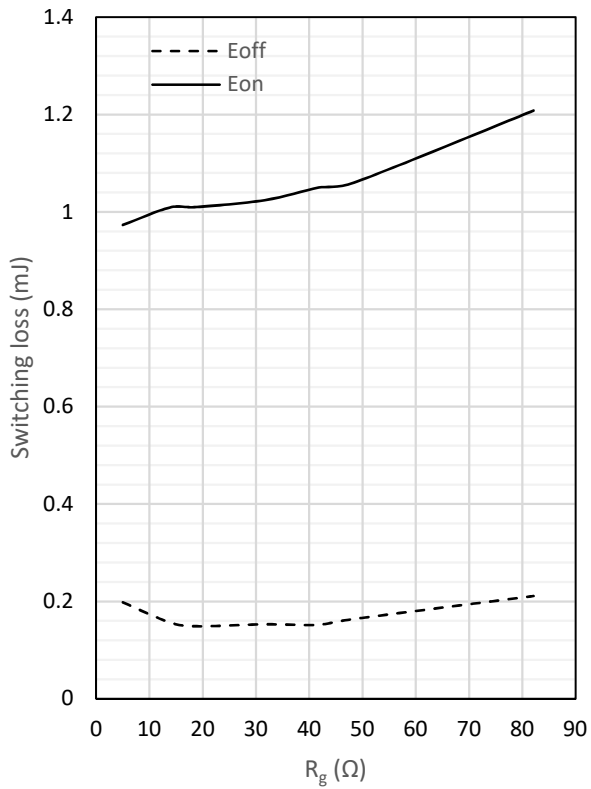


Fig. 10 Switching loss vs. collector current

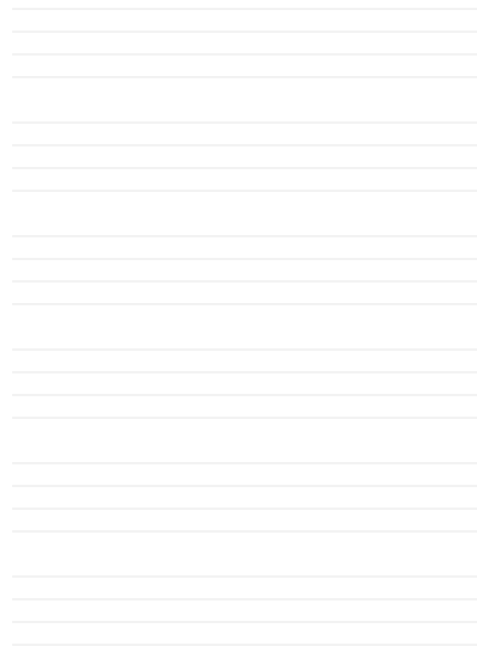
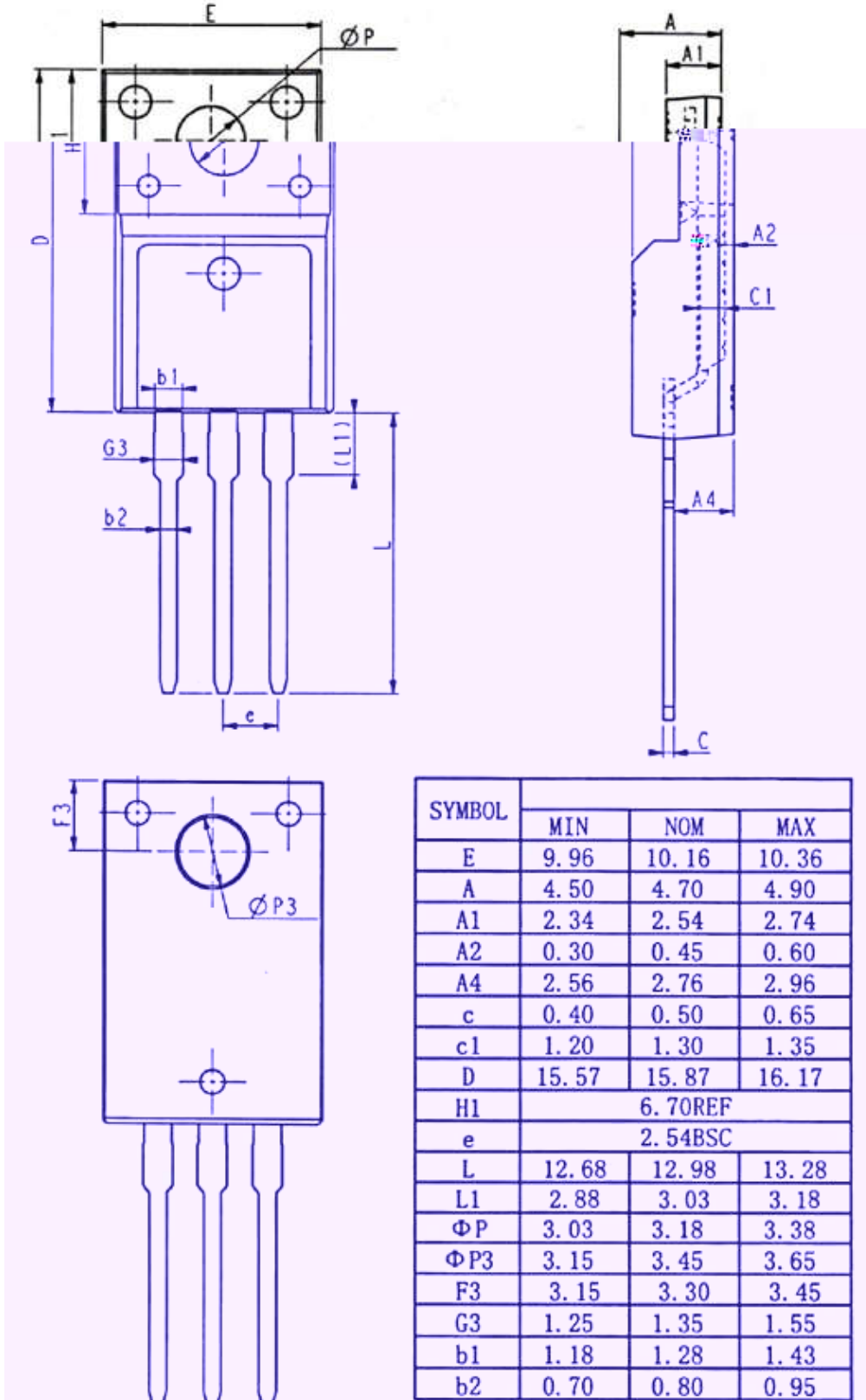


Fig. 11 Gate charge characteristics

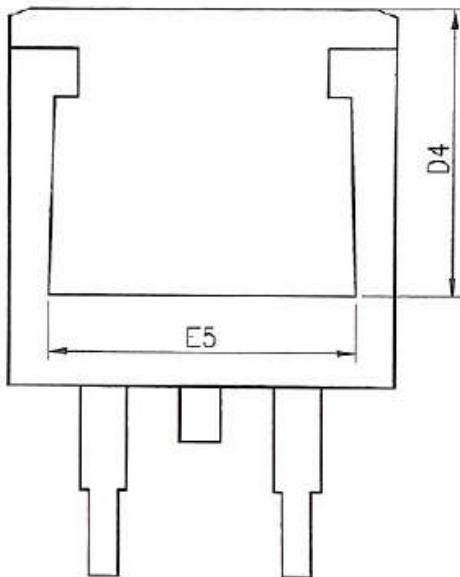
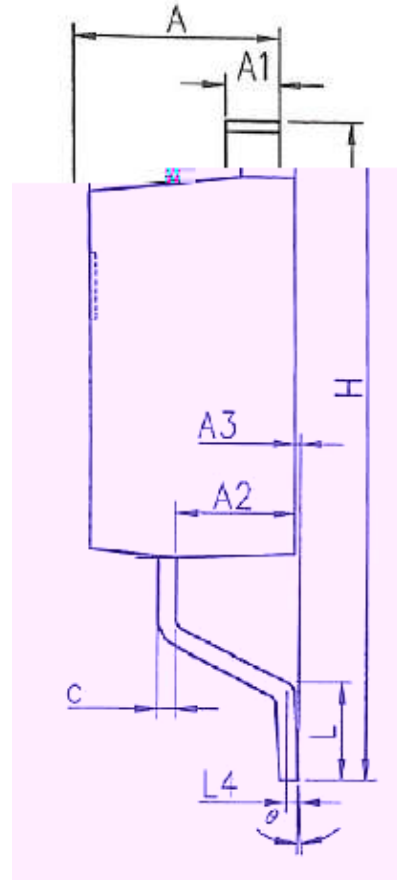
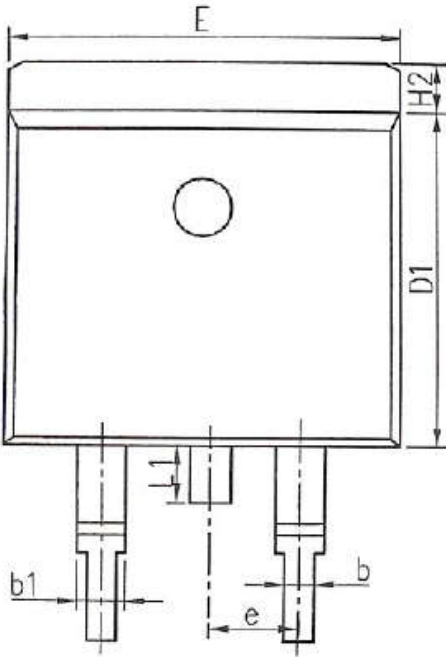
Fig. 12 Capacitance characteristics

**TO-220F package information**





**TO-263 package information**



SYMBOL	MM		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0.00	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.78	8.90
D4	6.60	-	-
E	9.88	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.70	15.50	16.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.50
L1	1.40	1.66	1.70
L4	0.25 BSC		
$\theta$	0°	5°	8°

**TO-220 package information**

SYMBOL	MIN	NOM	MAX
A	4.40	4.50	4.60
A1	1.27	1.30	1.33
A2	2.30	2.40	2.50
b	0.70	—	0.90
b1	1.27	—	1.40
c	0.45	0.50	0.60
D	15.30	15.70	16.10
D1	9.10	9.20	9.30
D2	13.10	—	13.70
E	9.70	9.90	10.20
E1	7.80	8.00	8.20
e	2.54BSC		
e1	5.08BSC		
H1	6.30	6.50	6.70
L	12.78	13.08	13.38
L1	—	—	3.50
L2	4.60REF		
∅P	3.55	3.60	3.65
Q	2.73	—	2.87
θ1	1°	3°	5°

