QMX6N65ESF

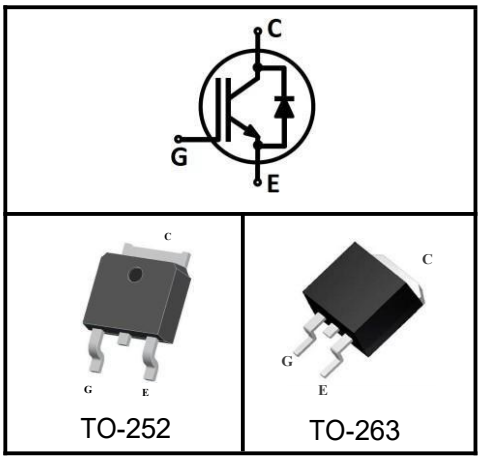
650V-6A Trench and Field Stop IGBT

Features

- Easy parallel switching capability due to positive temperature coefficient in V_{CEsat}
- Low V_{CEsat}， fast switching
- High ruggedness, good thermal stability
- Very tight parameter distribution

Applications

- Motor Drives
- Fan, Pumps, Vacuum Cleaner



Type	Marking	Package Code
QMD6N65ESF	QMD6N65ESF	TO-252
QMC6N65ESF	QMC6N65ESF	TO-263

Maximum Rated Values [1]

Parameter	Symbol	Value		Unit
		TO-252	TO-263	
Collector-emitter voltage	V_{CE}	650		V
DC collector current[2]				A
T_C=25℃	I_C	10		
T_C=100℃		6		
Pulsed collector current[3]	I_{Cpuls}	18		
Diode forward current[2]				
T_C=25℃	I_F	10		
T_C=100℃		6		
Diode pulsed current[3]	I_{Fpuls}	18		
Short circuit withstanding time V_{GE} = 15V, V_{CC} ≤ 400V, T_J ≤150℃	t_{SC}	5		us
Gate-emitter voltage	V_{GE}	±20		V
Transient Gate-emitter voltage（t_p≤10us)		±30		
Power dissipation				W
T_C=25℃	P_{tot}	100		
T_C=100℃		50		
Operating junction temperature	T_j	-55~175		℃
Storage temperature	T_{stg}	-55~150		

1:Reference standard: JESD-022 2: limited by Tjmax 3: Tp limited by Tjmax ;

Thermal Characteristics

Parameter	Symbol	TO-252	TO-263	Unit
IGBT thermal resistance, junction-case	R_{thJC}	1.5	1.5	K/W
Diode thermal resistance, junction-case	R_{thJCD}	2.1	2.6	
Thermal Resistance, junction-ambient	R_{thJA}	72	51	

Electrical Characteristics（at Tj=25℃, unless otherwise specified）

Static Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE}=0V, I_C=0.25mA	650	-	-	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	V_{GE}=15V, I_C=6A T_j=25℃	-	1.40	1.80	
		T_j=125℃	-	1.46	-	
		T_j=150℃	-	1.49	-	
Diode forward voltage	V_F	V_{GE}=0V，I_F=6A T_j=25℃	-	1.70	2.10	
		T_j=125℃	-	1.60	-	
		T_j=150℃	-	1.55	-	
G-E threshold voltage	$V_{GE(th)}$	I_C=150uA,V_{CE}=V_{GE}	4.7	5.7	6.7	
C-E leakage current	I_{CES}	V_{CE}=650V, V_{GE}=0V T_j=25℃	-	-	0.01	mA
		T_j=150℃	-	-	1.0	
G-E leakage current	I_{GES}	V_{CE}=0V, V_{GE}=20V	-	-	250	nA
Transconductance	g_{FS}	V_{CE}=20V, I_C=6A	-	2	-	S

Dynamic Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input capacitance	C_{iss}	V_{CE}=25V, V_{GE}=0V, f=1MHz	-	575	-	pF
Output capacitance	C_{oss}		-	33	-	
Reverse transfer capacitance	C_{rss}		-	5	-	
Gate charge	Q_G	V_{CC}=300V, I_C=6A, V_{GE}=15V	-	25	-	nC

IGBT Switching Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Turn-on delay time	$t_{d(on)}$	T_j=25℃, V_{CC}=400V, I_C=6A, V_{GE}=0/15V, R_G=10Ω, Inductive load	-	60	-	ns
Rise time	t_r		-	36	-	
Turn-off delay time	$t_{d(off)}$		-	87	-	
Fall time	t_f		-	102	-	
Turn-on energy	E_{on}		-	0.129	-	mJ
Turn-off energy	E_{off}		-	0.129	-	
Total switching energy	E_{ts}		-	0.258	-	
Turn-on delay time	$t_{d(on)}$	T_j=150℃, V_{CC}=400V, I_C=6A, V_{GE}=0/15V, R_G=10Ω, Inductive load	-	54	-	ns
Rise time	t_r		-	27.6	-	
Turn-off delay time	$t_{d(off)}$		-	129	-	
Fall time	t_f		-	140	-	
Turn-on energy	E_{on}		-	0.173	-	mJ
Turn-off energy	E_{off}		-	0.183	-	
Total switching energy	E_{ts}		-	0.356	-	

Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode reverse recovery time	t_{rr}	T_j=25℃, V_R=400V, I_F=6A, di_F/dt=200A/μs	-	79	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.178	-	μC
Diode peak reverse recovery current	I_{rrm}		-	3.5	-	A
Diode reverse recovery time	t_{rr}	T_j=150℃, V_R=400V, I_F=6A, di_F/dt=200A/μs	-	151	-	ns
Diode reverse recovery charge	Q_{rr}		-	0.475	-	μC
Diode peak reverse recovery current	I_{rrm}		-	6.4	-	A

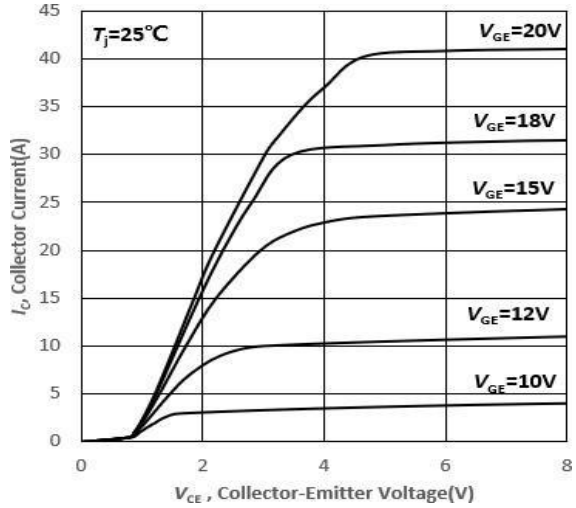


Figure 1. Typical output characteristic

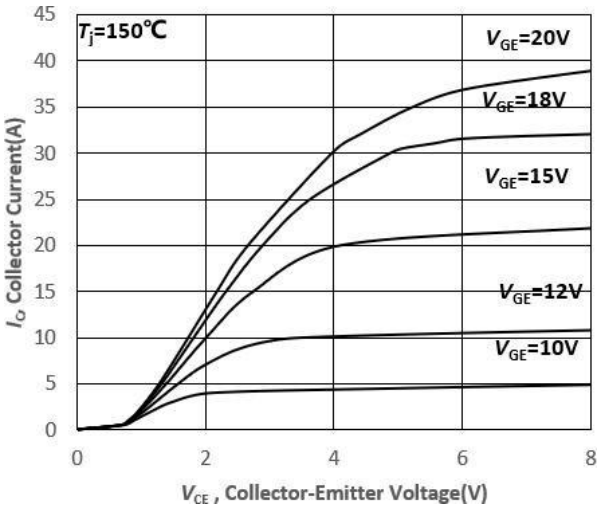


Figure 2. Typical output characteristic

(T_j=25℃)

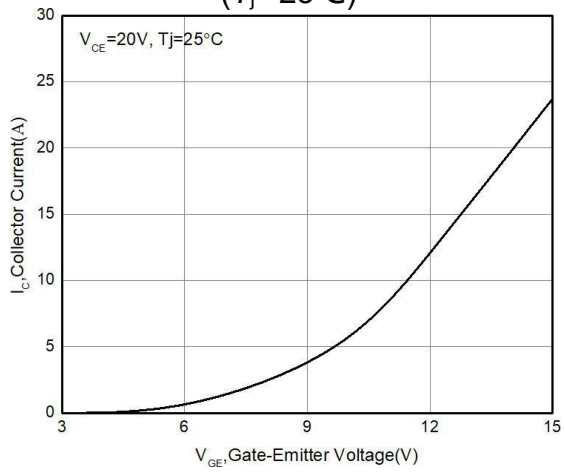


Figure 3. Typical transfer characteristic

(T_j=150℃)

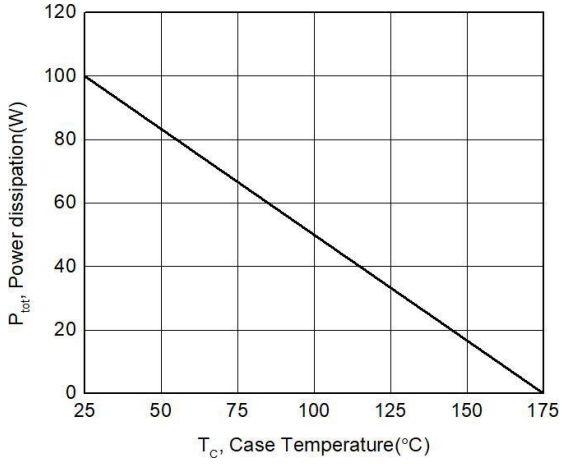


Figure 4. Power dissipation as a function of case temperature (TJ≤175℃)

(T_j=25℃)

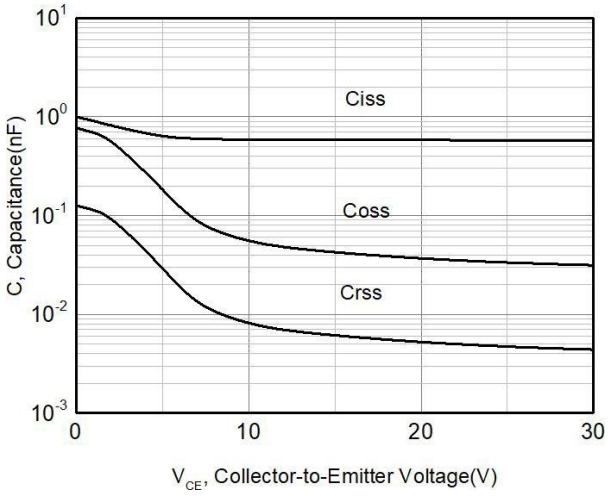


Figure 5. Capacitance characteristic (V_{GE}=0V, f=1MHz)

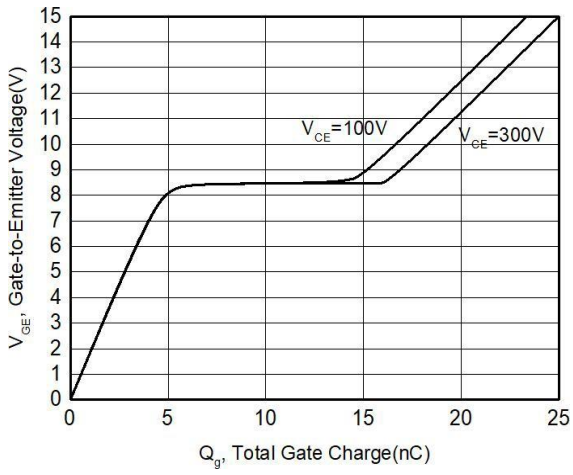


Figure 6. Typical gate charge (IC=6A)

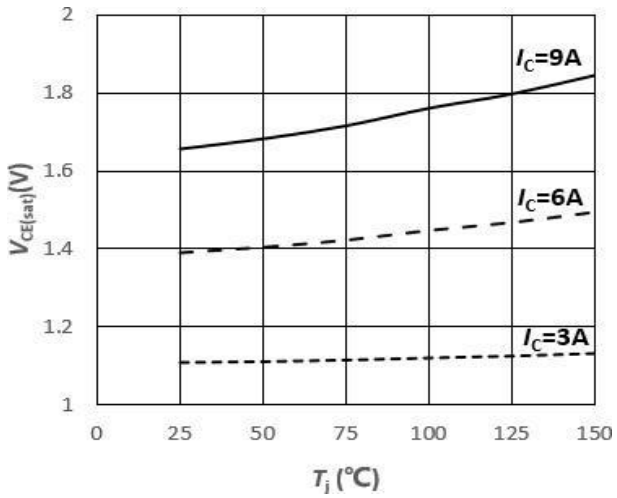


Figure 7. V_{CESAT} as a function of junction temperature (V_{GE}=15V)

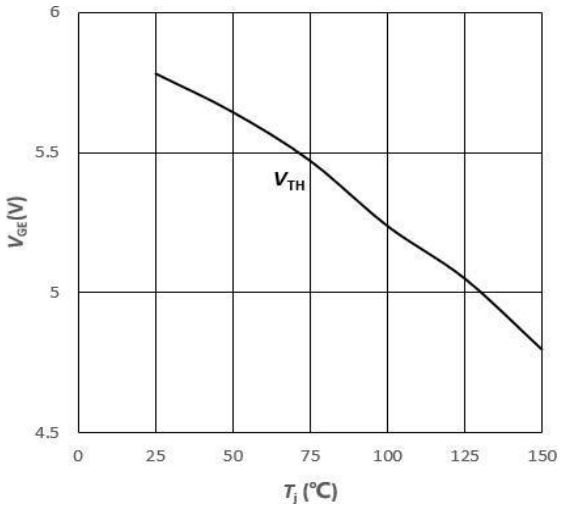


Figure 8. V_{TH} as a function of junction temperature (I_{CE}=250uA)

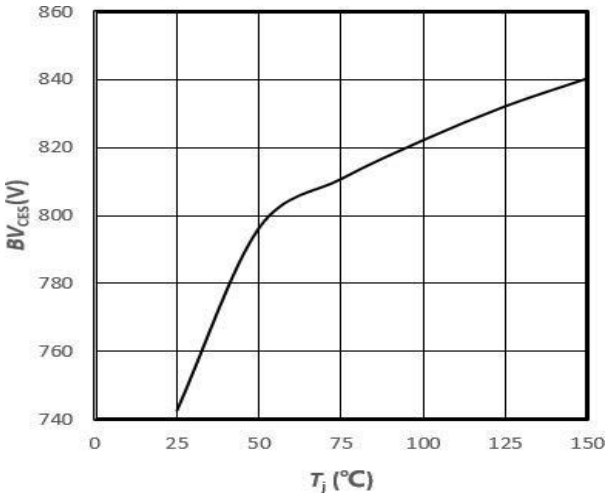


Figure 9. BV as a function of junction temperature (I_{CE}=250uA)

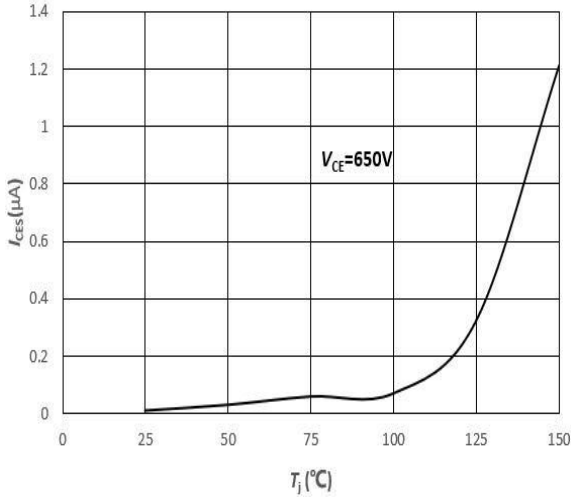


Figure 10. I_{CES} leakage current as a function of junction temperature

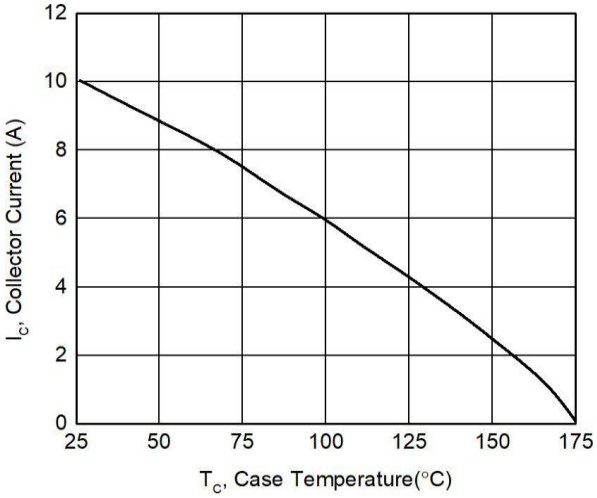


Figure 11. Collector current as a function of case temperature(V_{GE}≥15V, T_j≤150 ℃)

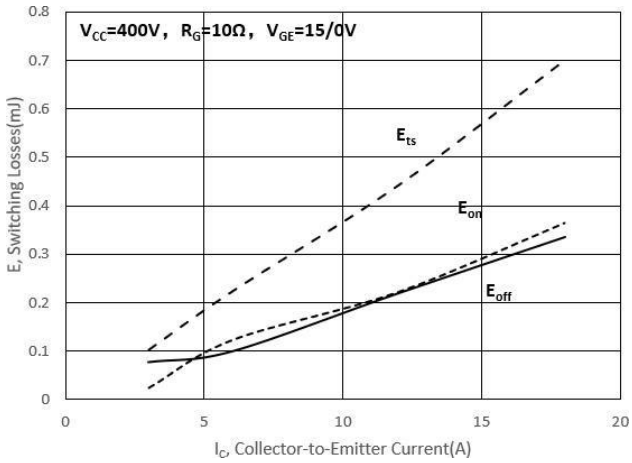


Figure 12. E_{on}, E_{off} as a function of I_C (T_j=25 ℃)

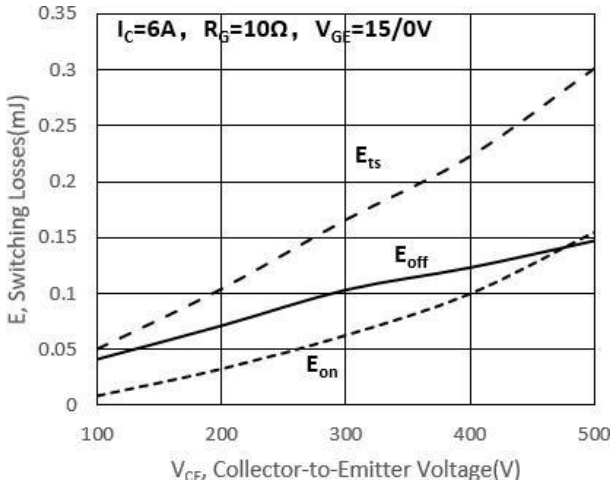


Figure 13. E_{on}, E_{off} as a function of V_{CE} (T_j=25 ℃)

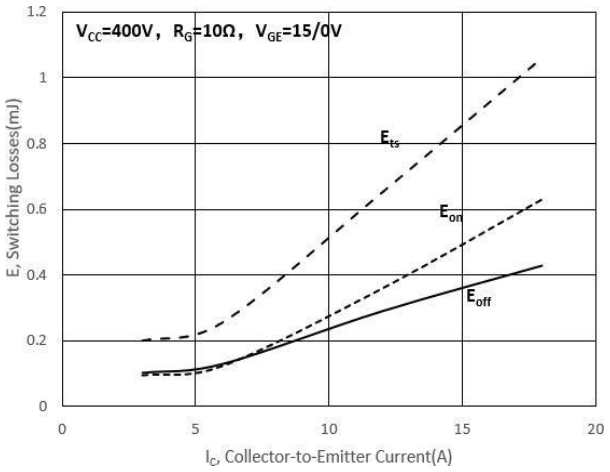


Figure 14. E_{on}, E_{off} as a function of I_C (T_j=150 ℃)

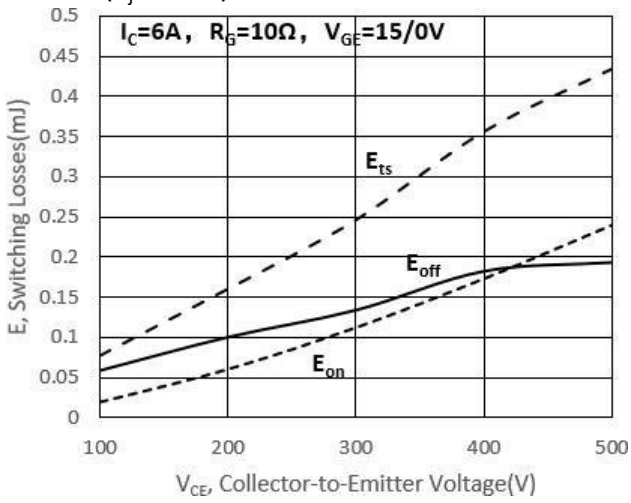


Figure 15. E_{on}, E_{off} as a function of V_{CE} (T_j=150 ℃)

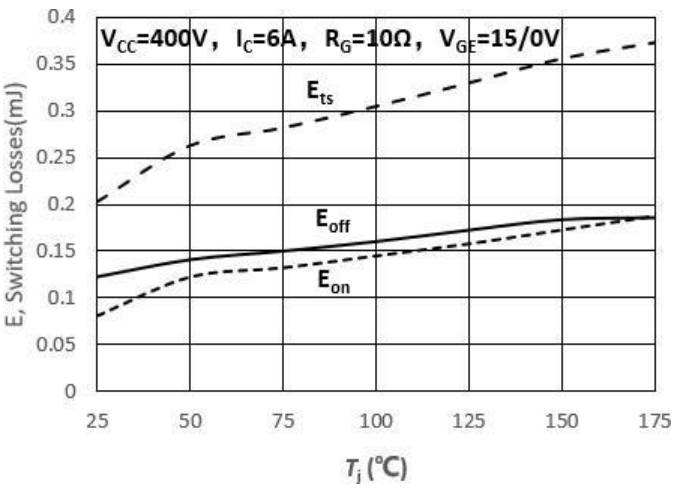


Figure 16. E_{on}, E_{off} as a function of junction temperature

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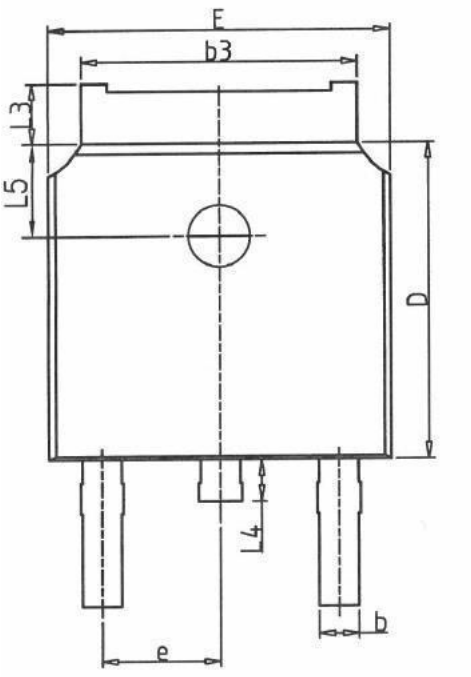
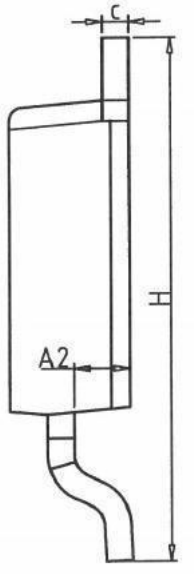
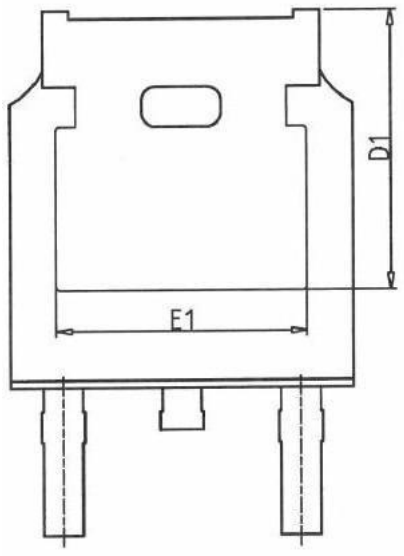
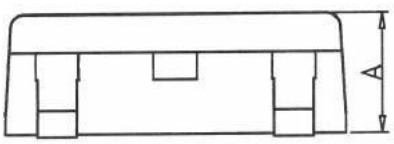
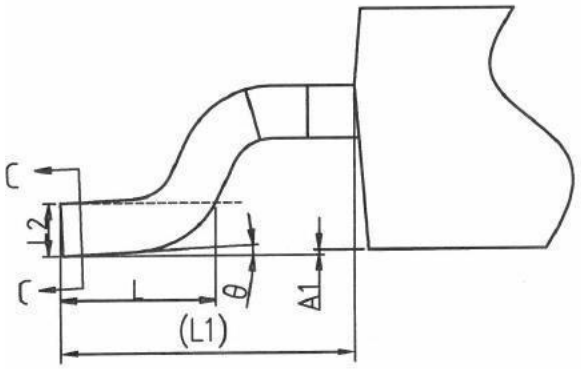




SYMBOL	mm		
	Min	Nom	Max
A	2.20	2.30	2.38
A1	0.00	-	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.73
E1	4.63	-	-
e	2.286BSC		
H	9.40	10.10	10.50
L	1.38	1.50	1.75
L1	2.90REF		
L2	0.51BSC		
L3	0.88	-	1.28
L4	0.50	-	1.00
L5	1.65	1.80	1.95
θ	0°	-	8°







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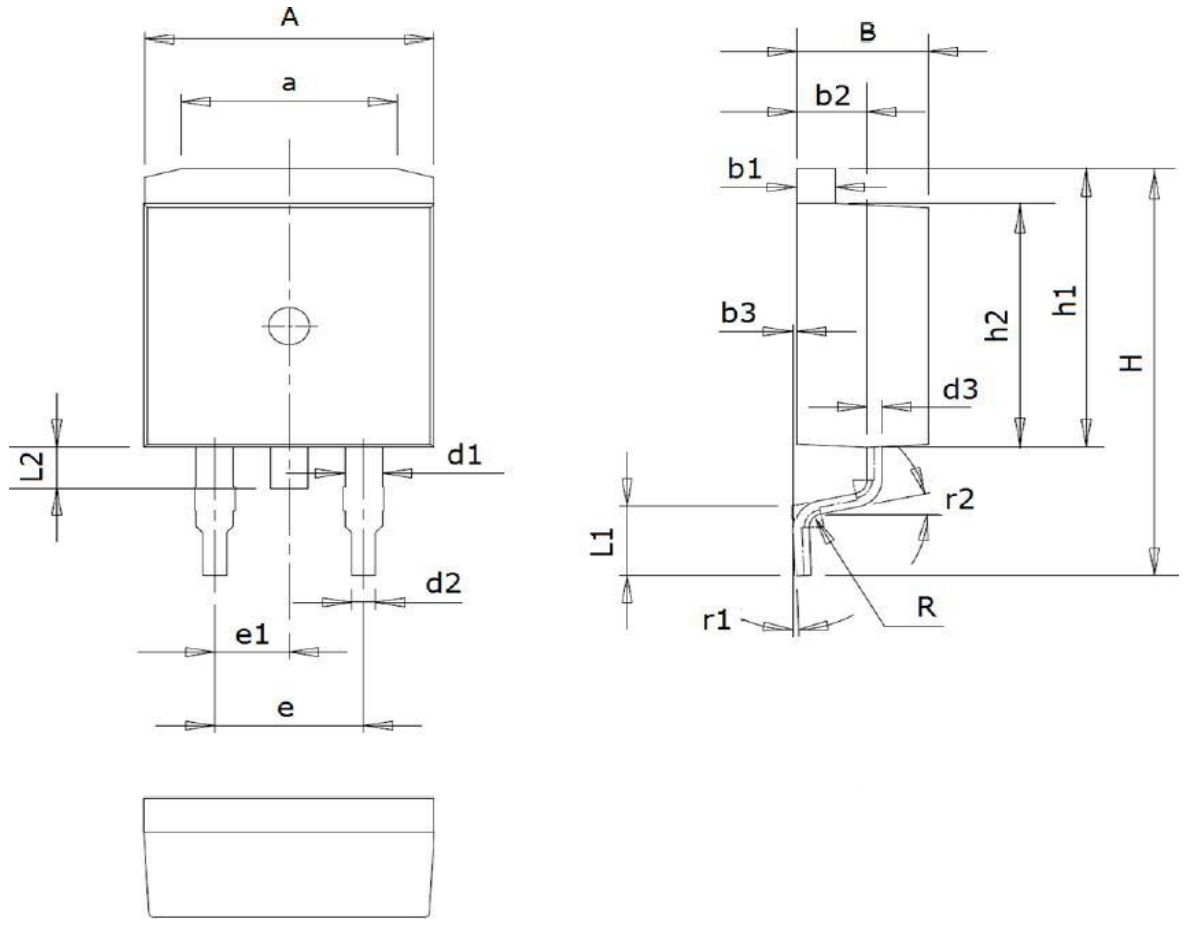

Symbol	Dimensions (mm)	Symbol	Dimensions (mm)	Symbol	Dimensions (mm)
A	9.86~10.26	d2	0.7~0.96	L1	2.0~2.6
a	7.0~7.8	d3	0.3~0.53	L2	1.3~1.8
B	4.37~4.77	e	5.08	R	0.5
b1	1.22~1.42	e1	2.54	r1	0-9°
b2	2.2~2.6	H	14.7~15.5	r2	12°
b3	0~0.25	h1	10.3~10.7		
d1	1.17~1.47	h2	9.1~9.4		

Revision: 2022-12, Rev. 1.5

Revision	Date	Subjects (major changes since last revision)
1.0	2021-10	Initial version
1.1	2022-02	Add the graphs
1.2	2022-05	Update electrical characteristics
1.3	2022-07	Add charts
1.4	2022-10	Update Diode characteristics
1.5	2022-12	Update IGBT Switching characteristics

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