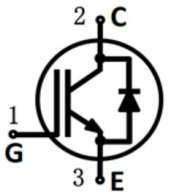
HCKD5N65AM2 is a **650V5A** IGBT discrete with high speed soft switching of Trench Field stop technology.The product with a anti-parallel diode,has the characteristics of low V_{cesat},high junction temperature and strong robustness. It is very suitable for products with motor and fans driver.

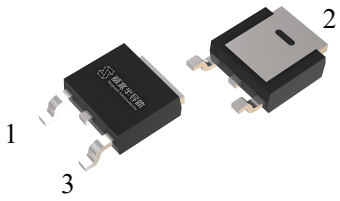
■ Features



- CoolWatt®Ⅱ Trench-FS technology
- Low V_{CESAT}
- Low switching losses
- With anti-parallel fast recovery diode
- Positive temperature coefficient
- High reliability

■ Applications

- Motor driver
- Fans driver
- Refrigerator etc Appliance application



TO-252

Part ID	V_{CE}(V)	I_{CNOM}(A)	$V_{CESAT@25℃}$(V)	Package	Marking
HCKD5N65AM2	650	5	1.45	TO-252	K5M652

■ Maximum Rated Values

Symbol	Parameter	Condition	Value	Unit
V_{CES}	Collector-emitter voltage	T_{vj}=25℃	650	V
I_C	DC collector current	T_C = 25℃ T_C =100℃	10 5	A
I_{Cpuls}	Pulse collector current	T_{vj}≤150℃	15	A
V_{RRM}	Repetitive peak reverse voltage	T_{vj}=25℃	650	V
I_F	Diode continuous forward current	T_C = 25℃ T_C = 100℃	10 5	A
I_{Fpuls}	Diode pulse current	T_{vj}≤150℃	15	A
V_{GE}	Gate-emitter voltage	T_{vj}=25℃ Transient（tp≤10uS,D＜0.01）	±20 ±30	V

t_{sc}	Short circuit withstand time	Vcc≤400V,R_g=51Ω, V_{GE}=0/15V	5	uS
I_{SC}	Short current	Vcc≤400V,R_g=51Ω, V_{GE}=0/15V	48	A
P_{tot}	Power dissipation	T_C = 25℃	69	W
T_{vj}	Operating junction temperature		-40~+150	℃
T_{stg}	Storage temperature		-50~ +150	℃

■ Thermal Characteristic

Symbol	Parameter	Maximum	Unit
$R_{thJC-IGBT}$	IGBT thermal resistance junction-case	1.80	K/W
$R_{thJC-FRD}$	FRD thermal resistance junction-case	4.50	K/W
R_{thJA}	Thermal resistance junction-ambient	55	K/W

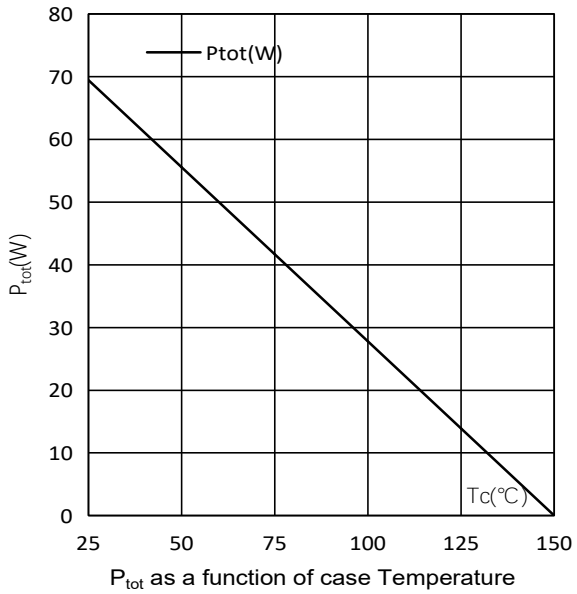
■ Electrical Characteristic

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)CES}$	Collector-emitter breakdown voltage	V_{GE} = 0V, I_C=0.25mA,T_{vj}=25℃	650	—	—	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}=15V, I_C=5A, T_{vj}=25℃	—	1.45	1.85	
		T_{vj}=150℃	—	1.60	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{GE}= V_{CE},I_C=1.5mA,T_{vj}=25℃	5.80	6.35	6.80	
V_F	Diode forward voltage	V_{GE}= 0V,I_F=5A, T_{vj}=25℃	—	1.75	2.05	
		T_{vj}=150℃	—	1.65	—	
I_{GES}	Zero collector voltage gate current	V_{GE}=30V,V_{CE}=0V	—	—	200	nA
I_{CES}	Zero gate voltage collector current	V_{CE} =650V,V_{GE}=0V, T_{vj}=25℃	—	—	0.20	mA
		T_{vj}=150℃	—	—	0.50	
R_{Gin}	Integrated gate resistor	—	—	0	—	Ω
C_{ies}	Input capacitance	V_{GE} = 0V,V_{CE}= 30V, f = 1MHz, T_{vj}=25℃	—	379	—	pF
C_{oes}	Output capacitance		—	26.1	—	
C_{res}	Reverse transfer capacitance		—	5.61	—	
Q_g	Gate charge	V_{GE}=0/15V,V_{cc}=400V,I_C=5A, T_{vj}=25℃	—	12.5	—	nC
Q_{ge}	Gate-emitter charge		—	3.39	—	
Q_{gc}	Gate-collector charge		—	5.48	—	
V_{GE}(pl)	Gate-emitter plateau voltage	I_C =5A,V_{CE}=520V, V_{GE}=0/15V,T_{vj}=25℃	—	9.88	—	V

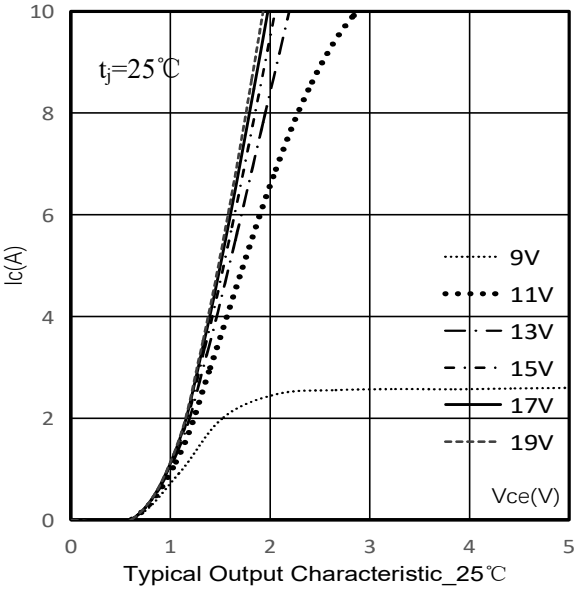
■ Dynamic Characteristic（With inductive load）

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
IGBT Characteristic_25℃：						
$T_{d(on)}$	Turn-on delay time	Vcc=400V,Ic=5A, Ron=51Ω, Roff=51Ω, Cge=0nF,V_{GE}=0/15V, L_{load}=500uH,T_{vj}=25℃	—	30.8	—	ns
T_r	Rise time		—	15.0	—	
$T_{d(off)}$	Turn-off delay time		—	95.2	—	
t_f	Fall time		—	57.4	—	
E_{on}	Turn-on energy		—	86.4	—	uJ
E_{off}	Turn-off energy		—	89.0	—	
E_{total}	Total switch energy		—	175.4	—	
IGBT Characteristic_150℃：						
$T_{d(on)}$	Turn-on delay time	Vcc=400V,Ic=5A, Ron=51Ω, Roff=51Ω, Cge=0nF,V_{GE}=0/15V, L_{load}=500uH,T_{vj}=150℃	—	29.0	—	ns
T_r	Rise time		—	18.4	—	
$T_{d(off)}$	Turn-off delay time		—	106	—	
t_f	Fall time		—	61.3	—	
E_{on}	Turn-on energy		—	113	—	uJ
E_{off}	Turn-off energy		—	106	—	
E_{total}	Total switch energy		—	219	—	
Diode Characteristic_25℃：						
Erec	Reverse recovery energy	I_F =5A,V_R=400V, V_{GE} =0/15V,R_{ON}=51Ω,T_{vj}=25℃	—	24.1	—	uJ
trr	Diode reverse recovery time		—	40.3	—	nS
Qrr	Diode reverse recovery charge		—	118	—	nC
Irrm	Diode peak reverse recovery current		—	5.25	—	A
di_{rr}/dt	Diode peak rate of fall of reverse Recovery current during t_{rr}		—	259	—	A/uS
Diode Characteristic_150℃：						
Erec	Reverse recovery energy	I_F=5A,V_R=400V,V_{GE}=0/15V, R_{ON}=51Ω,T_{vj}=150℃	—	49.4	—	uJ
trr	Diode reverse recovery time		—	89.7	—	nS
Qrr	Diode reverse recovery charge		—	218	—	nC
Irrm	Diode peak reverse recovery current		—	5.64	—	A
di_{rr}/dt	Diode peak rate of fall of reverse Recovery current during t_{rr}		—	227	—	A/uS

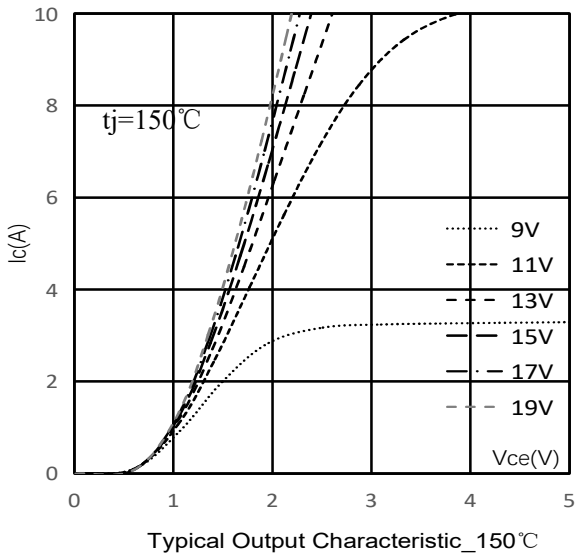
■ Characteristic Curve



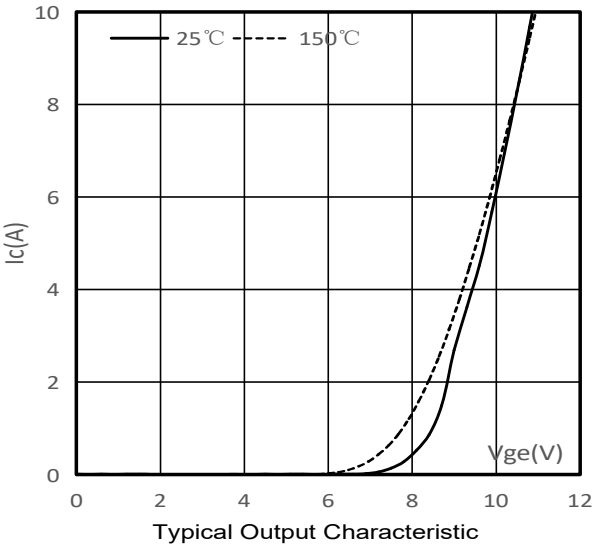
P_{tot} as a function of case Temperature



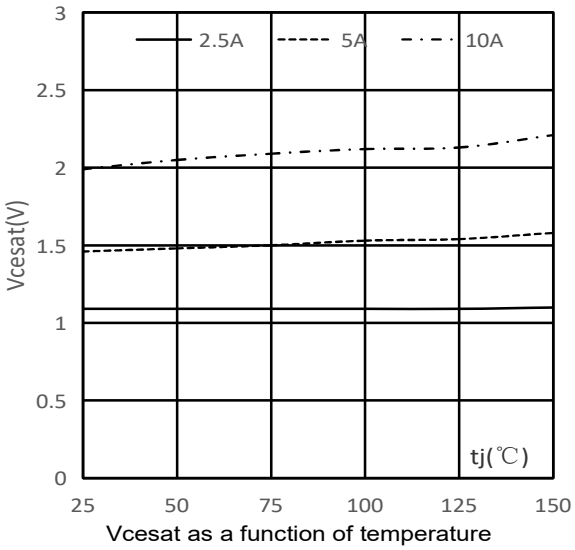
Typical Output Characteristic_25℃



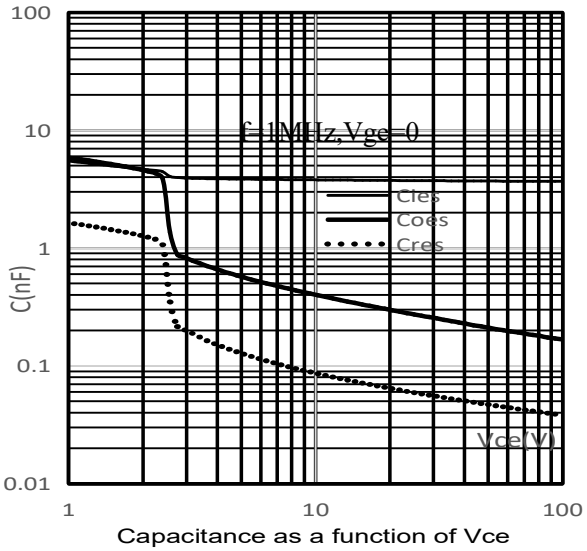
Typical Output Characteristic_150℃



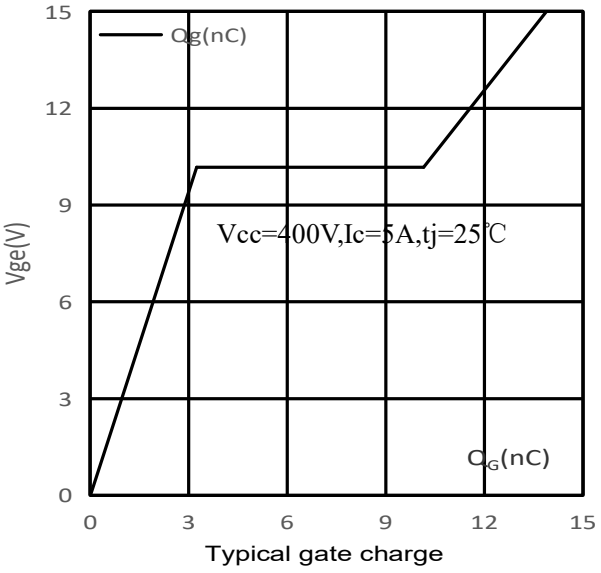
Typical Output Characteristic

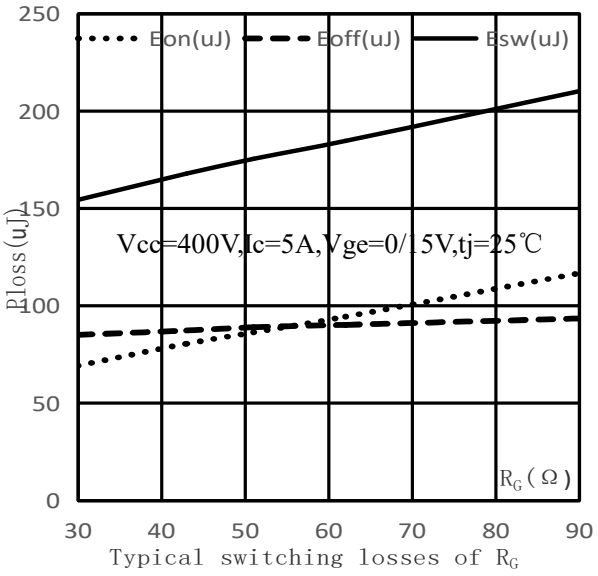


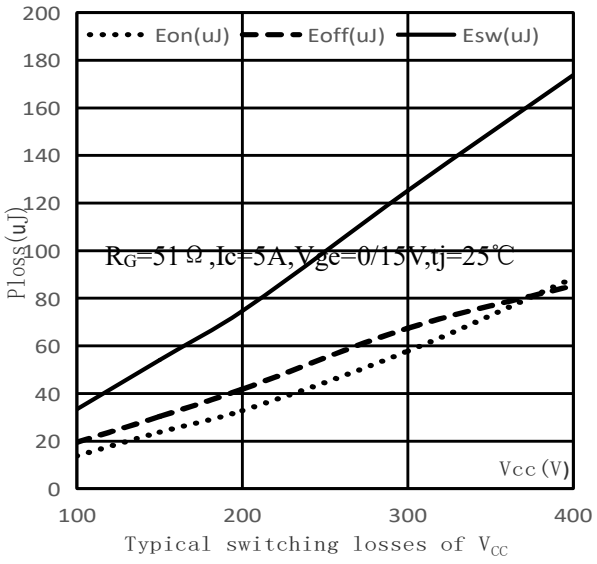
Vcesat as a function of temperature

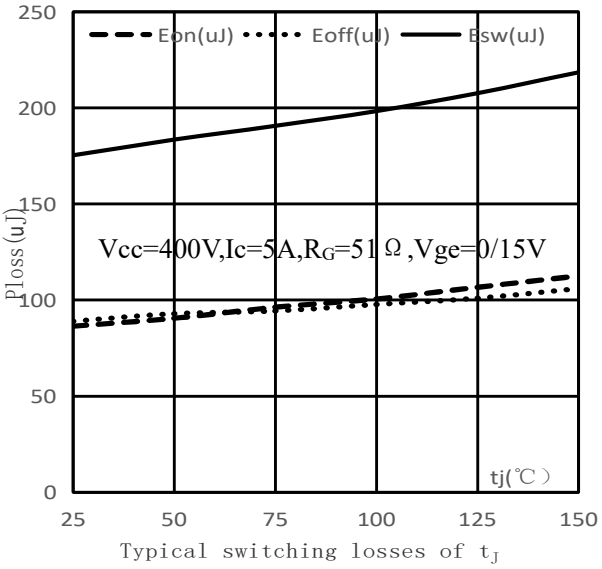


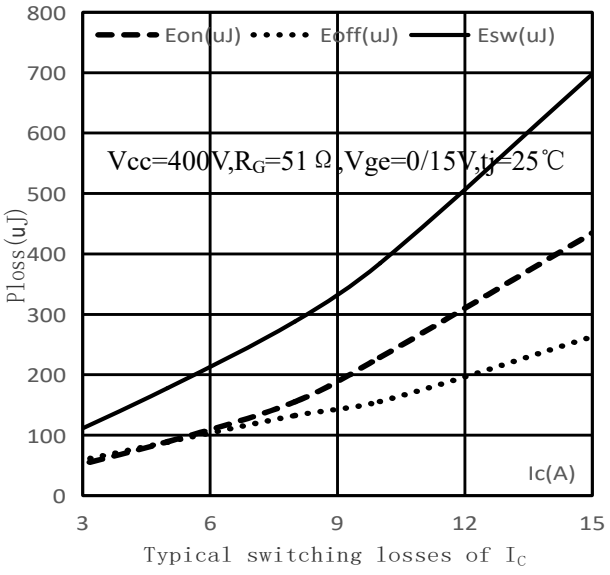
Capacitance as a function of Vce

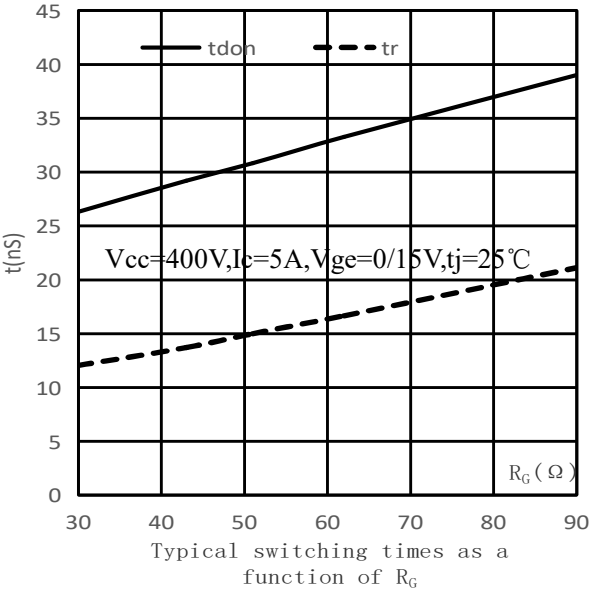

Qg(nC)
Vcc=400V,Ic=5A,tj=25℃
Vge(V)
Q_G(nC)
Typical gate charge

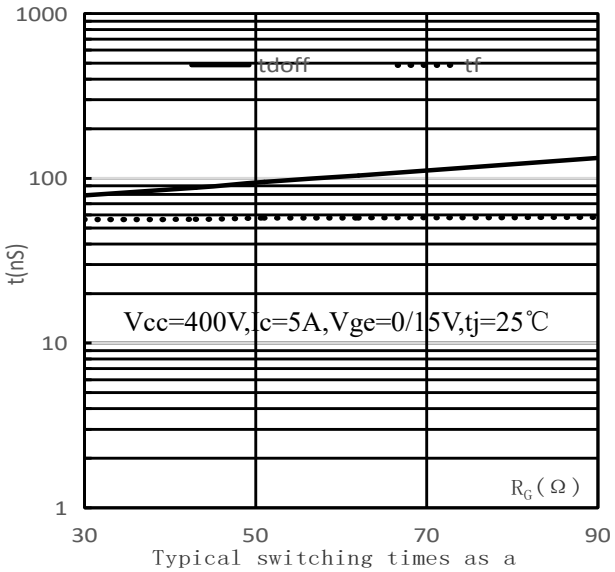

Eon(uJ)
Eoff(uJ)
Esw(uJ)
Vcc=400V,Ic=5A,Vge=0/15V,tj=25℃
Ploss(uJ)
R_G(Ω)
Typical switching losses of R_G


Eon(uJ)
Eoff(uJ)
Esw(uJ)
R_G=51Ω,Ic=5A,Vge=0/15V,tj=25℃
Ploss(uJ)
Vcc(V)
Typical switching losses of V_{CC}

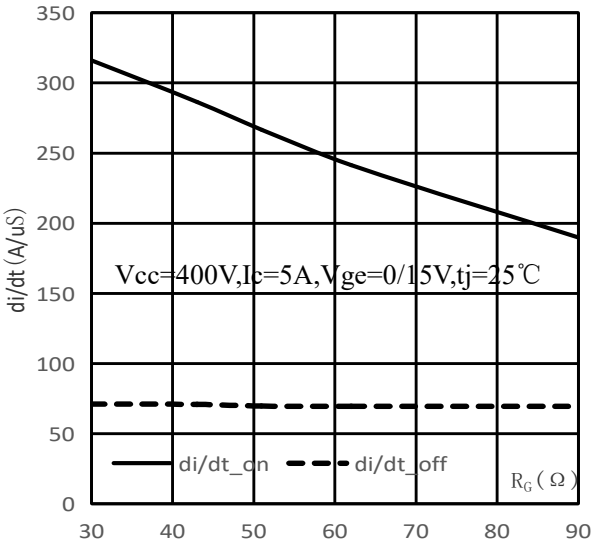

Eon(uJ)
Eoff(uJ)
Esw(uJ)
Vcc=400V,Ic=5A,R_G=51Ω,Vge=0/15V
Ploss(uJ)
tj(℃)
Typical switching losses of t_J


Eon(uJ)
Eoff(uJ)
Esw(uJ)
Vcc=400V,R_G=51Ω,Vge=0/15V,tj=25℃
Ploss(uJ)
Ic(A)
Typical switching losses of I_C

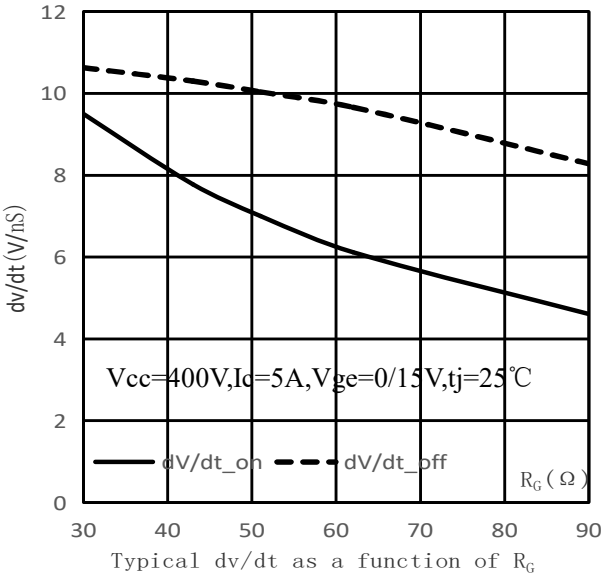

tdon
tr
Vcc=400V,Ic=5A,Vge=0/15V,tj=25℃
t(nS)
R_G(Ω)
Typical switching times as a function of R_G



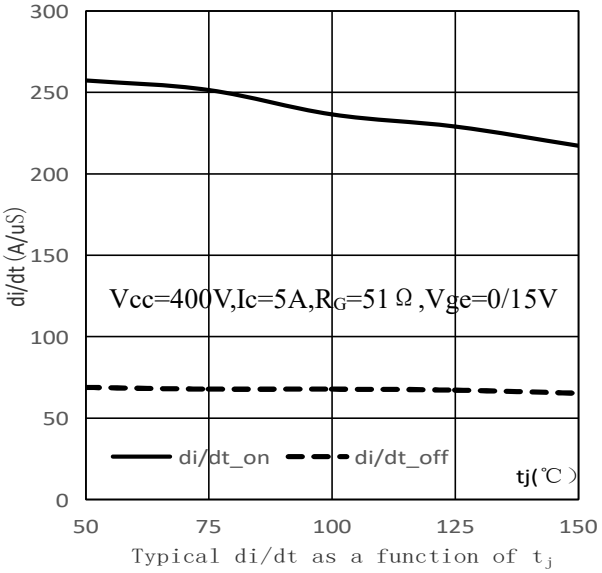
Typical switching times as a function of R_G



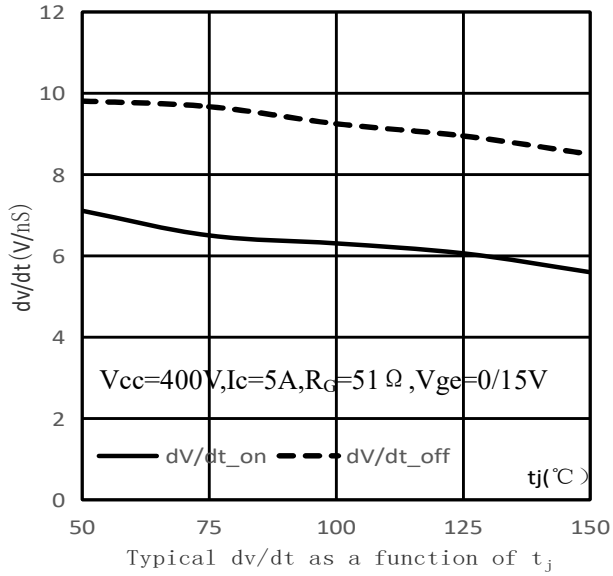
Typical di/dt as a function of R_G



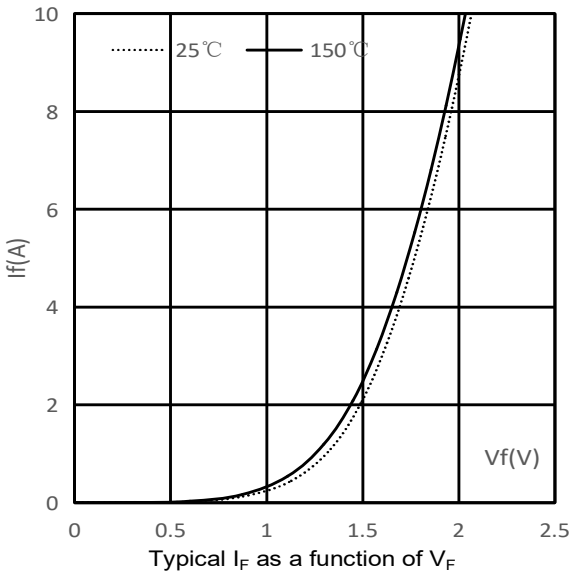
Typical dv/dt as a function of R_G



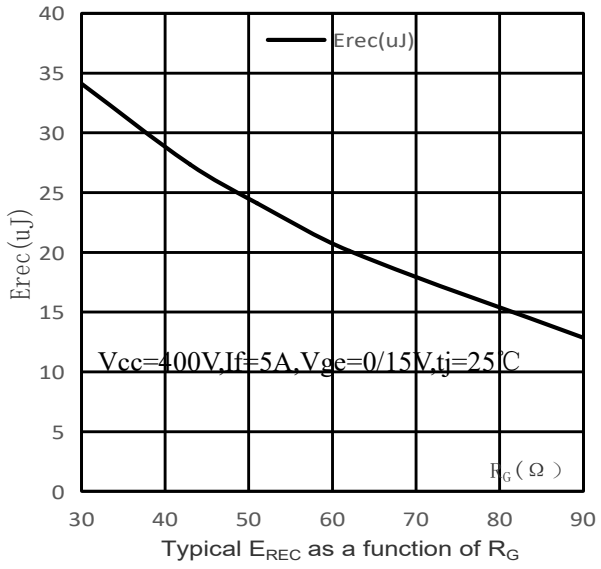
Typical di/dt as a function of t_j



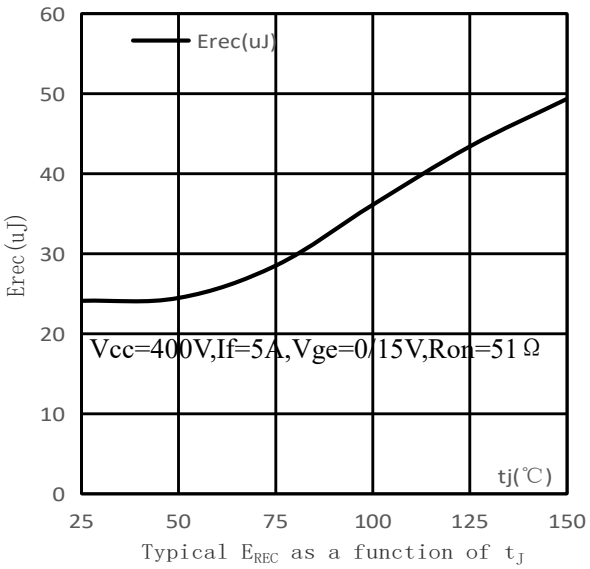
Typical dv/dt as a function of t_j



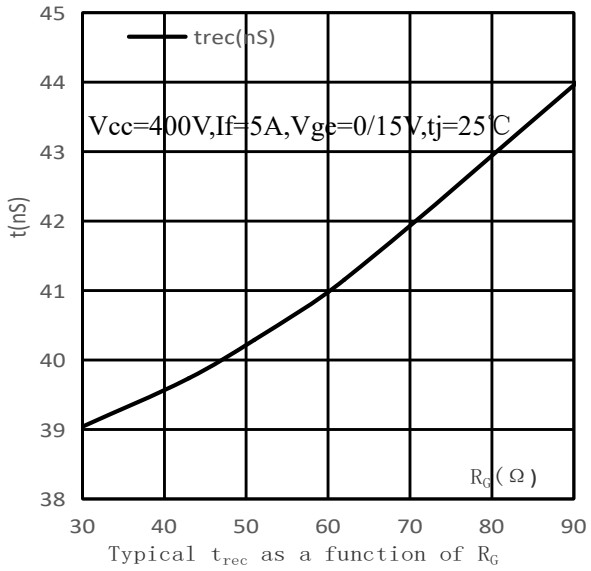
Typical I_F as a function of V_F



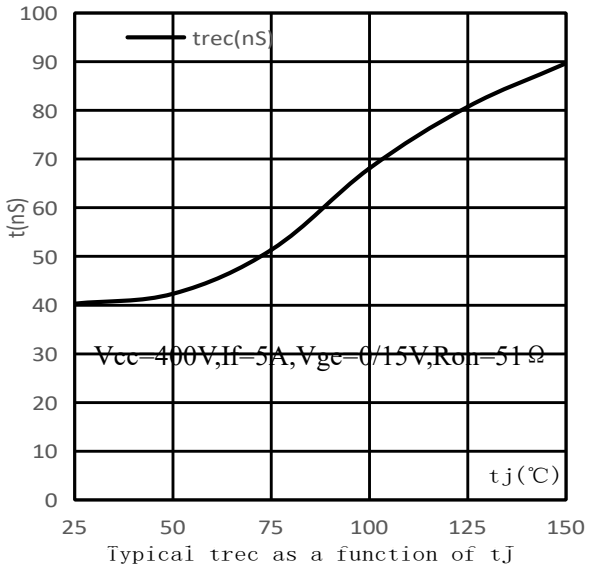
Typical E_{REC} as a function of R_G



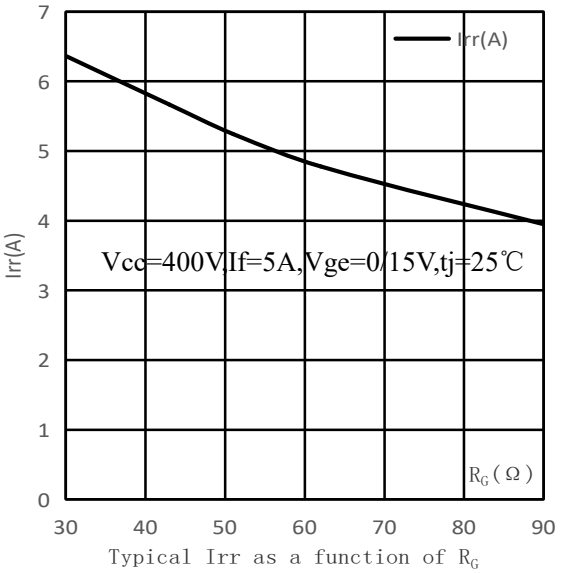
Typical E_{REC} as a function of t_J



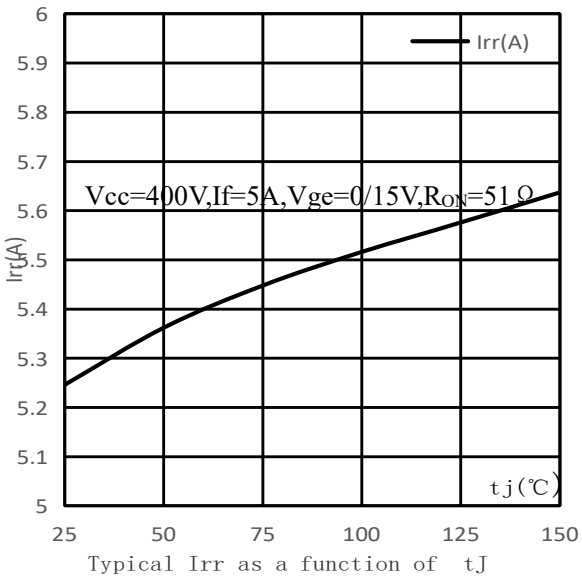
Typical t_{rec} as a function of R_G



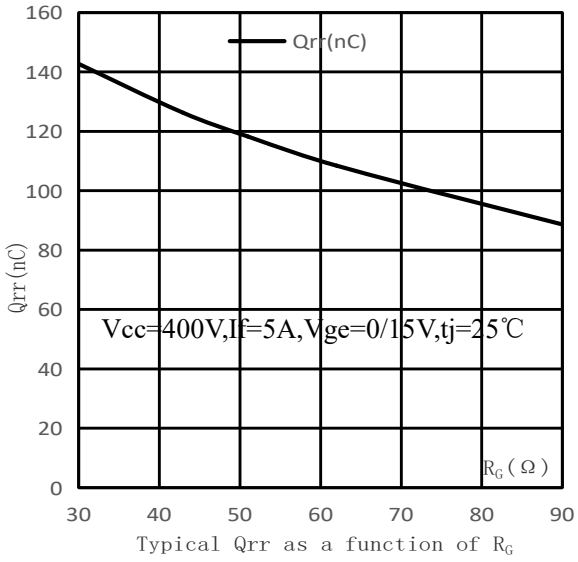
Typical trec as a function of tJ



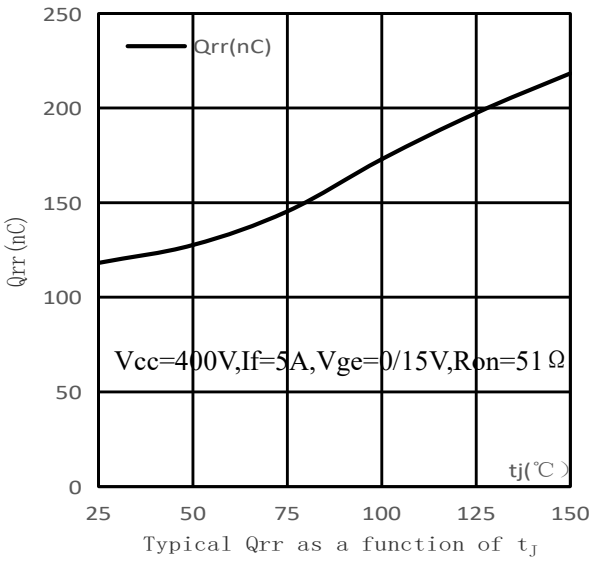
Typical Irr as a function of R_G



Typical Irr as a function of tJ

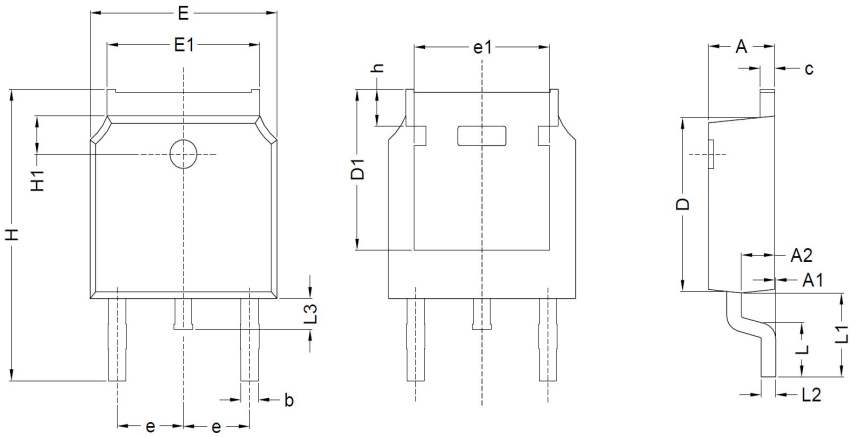


Typical Qrr as a function of R_G



Typical Qrr as a function of t_J

■ TO-252 Package Outline Data



Unit:mm

Symbol	Dimensions (unit: mm)		
	Min	Typ	Max
A	2.20	2.30	2.40
A1	--	--	0.20
A2	0.97	1.02	1.17
b	0.60	--	0.90
c	0.43	--	0.61
D	5.98	6.10	6.22
D1	5.15	5.25	5.35
E	6.40	6.60	6.73
E1	5.18	5.33	5.49
e	2.286 BSC		
e1	4.63	--	4.85
H	9.40	10.00	10.50
H1	1.50	--	1.95
h	0.88	--	1.35
L	1.38	1.50	1.75
L1	2.90 REF		
L2	0.51 BSC		
L3	0.50	--	1.00