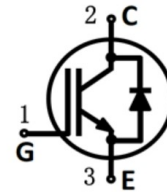


**HCKW60N65BH2A** is a **650V60A** IGBT discrete with high speed soft switching of Trench Field stop technology. The product with a anti-parallel diode, has the characteristics of low  $V_{CESAT}$ , high junction temperature and strong robustness. It is very suitable for products with high switching frequency.

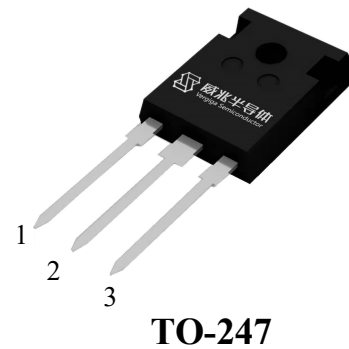
### ■ Features

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



### ■ Applications

- Power
- PV
- Industrial welding



Part ID	$V_{CE}(V)$	$I_{CNOM}(A)$	$V_{CESAT@25^{\circ}C}(V)$	Package	Marking
HCKW60N65BH2A	650	60	1.65	TO-247	K60H65B2A

### ■ Maximum Rated Values

Symbol	Parameter	Condition	Value	Unit
$V_{CES}$	Collector-emitter voltage	$T_{vj}=25^{\circ}C$	650	V
$I_C$	DC collector current	$T_C = 25^{\circ}C$	120	A
		$T_C = 100^{\circ}C$	60	
$I_{Cpuls}$	Pulse collector current	$T_{vj} \leq 150^{\circ}C$	180	A
$V_{RRM}$	Repetitive peak reverse voltage	$T_{vj}=25^{\circ}C$	650	V
$I_F$	Diode continuous forward current	$T_C = 25^{\circ}C$	120	A
		$T_C = 100^{\circ}C$	60	
$I_{Fpuls}$	Diode pulse current	$T_{vj} \leq 150^{\circ}C$	180	A

$V_{GE}$	Gate-emitter voltage	$T_{vj}=25^{\circ}C$ Transient ( $t_p \leq 10\mu s, D < 0.01$ )	$\pm 20$ $\pm 30$	V
$P_{tot}$	Power dissipation	$T_C = 25^{\circ}C$	375	W
$T_{vj}$	Operating junction temperature		-40~+ 175	$^{\circ}C$
$T_{stg}$	Storage temperature		-50~ + 150	$^{\circ}C$
M	Mounting torque	M3	0.6	Nm

## ■ Thermal Characteristic

Symbol	Parameter	Maximum	Unit
$R_{thJC-IGBT}$	IGBT thermal resistance junction-case	0.40	K/W
$R_{thJC-FRD}$	FRD thermal resistance junction-case	0.65	K/W
$R_{thJA}$	Thermal resistance junction-ambient	40	K/W

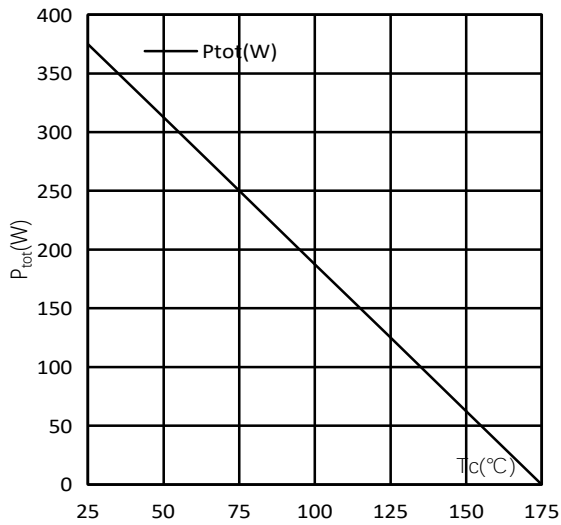
## ■ Electrical Characteristic

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)CES}$	Collector-emitter breakdown voltage	$V_{GE} = 0V,$ $I_C = 0.25mA, T_{vj} = 25^{\circ}C$	650	—	—	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15V, I_C = 60A, T_{vj} = 25^{\circ}C$ $T_{vj} = 150^{\circ}C$	— —	1.65 1.95	1.85 —	
$V_{GE(th)}$	Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 1.5mA, T_{vj} = 25^{\circ}C$	5.50	6.05	6.50	
$V_F$	Diode forward voltage	$V_{GE} = 0V, I_F = 60A, T_{vj} = 25^{\circ}C$ $T_{vj} = 150^{\circ}C$	— —	1.45 1.25	1.75 —	
$I_{GES}$	Zero collector voltage gate current	$V_{GE} = 30V, V_{CE} = 0V$	—	—	200	nA
$I_{CES}$	Zero gate voltage collector current	$V_{CE} = 650V, V_{GE} = 0V, T_{vj} = 25^{\circ}C$ $T_{vj} = 150^{\circ}C$	— —	—	0.20 0.50	mA
$R_{Gin}$	Integrated gate resistor	—	—	0	—	$\Omega$
$C_{ies}$	Input capacitance	$V_{GE} = 0V, V_{CE} = 30V,$ $f = 1MHz, T_{vj} = 25^{\circ}C$	—	5050	—	pF
$C_{oes}$	Output capacitance		—	190	—	
$C_{res}$	Reverse transfer capacitance		—	91.7	—	
$Q_g$	Gate charge	$I_C = 60A, V_{CE} = 520V,$ $V_{GE} = 15V, T_{vj} = 25^{\circ}C$	—	252	—	nC
$Q_{ge}$	Gate-emitter charge		—	39.0	—	
$Q_{gc}$	Gate-collector charge		—	132	—	
$V_{GE(pl)}$	Gate-emitter plateau voltage	$I_C = 60A, V_{CE} = 520V,$ $V_{GE} = 0/15V, T_{vj} = 25^{\circ}C$	—	8.80	—	V

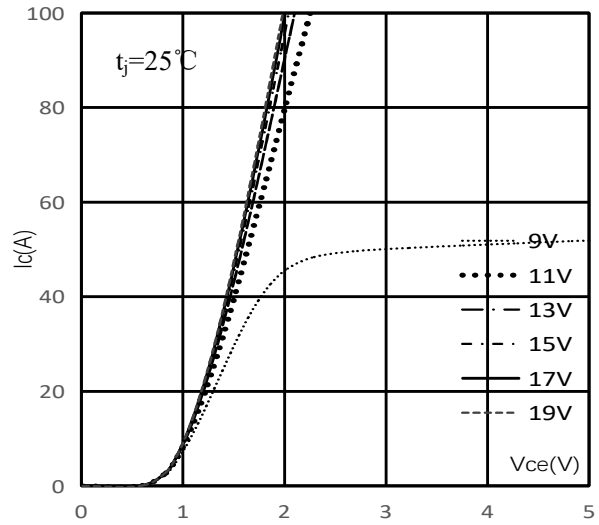
■ **Dynamic Characteristic (With inductive load)**

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
<b>IGBT Characteristic_25°C :</b>						
$T_{d(on)}$	Turn-on delay time	$V_{CC}=400V, I_c=60A,$ $R_{on}=20\ \Omega, R_{off}=20\ \Omega,$ $C_{ge}=0nF, V_{GE}=0/15V,$ $L_{load}=100uH, T_{vj}=25^\circ C$	—	126	—	ns
$T_r$	Rise time		—	136	—	
$T_{d(off)}$	Turn-off delay time		—	546	—	
$t_f$	Fall time		—	66.0	—	
$E_{on}$	Turn-on energy		—	2.52	—	mJ
$E_{off}$	Turn-off energy		—	2.13	—	
$E_{total}$	Total switch energy		—	4.65	—	
<b>IGBT Characteristic_150°C :</b>						
$T_{d(on)}$	Turn-on delay time	$V_{CC}=400V, I_c=60A,$ $R_{on}=20\ \Omega, R_{off}=20\ \Omega,$ $C_{ge}=0nF, V_{GE}=0/15V,$ $L_{load}=100uH, T_{vj}=150^\circ C$	—	109	—	ns
$T_r$	Rise time		—	135	—	
$T_{d(off)}$	Turn-off delay time		—	587	—	
$t_f$	Fall time		—	76.0	—	
$E_{on}$	Turn-on energy		—	3.43	—	mJ
$E_{off}$	Turn-off energy		—	2.44	—	
$E_{total}$	Total switch energy		—	5.87	—	
<b>Diode Characteristic_25°C :</b>						
$E_{rec}$	Reverse recovery energy	$I_F = 60\ A, V_R=400V,$ $V_{GE} = 0/15\ V, R_{ON}=20\ \Omega, T_{vj}=25^\circ C$	—	190	—	$\mu J$
$t_{rr}$	Diode reverse recovery time		—	142	—	nS
$Q_{rr}$	Diode reverse recovery charge		—	890	—	nC
$I_{rrm}$	Diode peak reverse recovery current		—	12.6	—	A
$di_{rr}/dt$	Diode peak rate of fall of reverse Recovery current during $t_{rr}$		—	289	—	A/uS
<b>Diode Characteristic_150°C :</b>						
$E_{rec}$	Reverse recovery energy	$I_F = 60\ A, V_R=400V,$ $V_{GE} = 0/15\ V, R_{ON}=20\ \Omega,$ $T_{vj}=150^\circ C$	—	902	—	$\mu J$
$t_{rr}$	Diode reverse recovery time		—	285	—	nS
$Q_{rr}$	Diode reverse recovery charge		—	3850	—	nC
$I_{rrm}$	Diode peak reverse recovery current		—	31.0	—	A
$di_{rr}/dt$	Diode peak rate of fall of reverse Recovery current during $t_{rr}$		—	201	—	A/uS

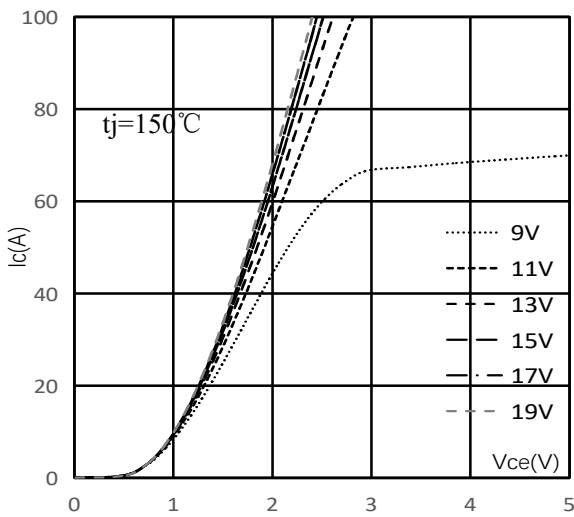
■ **Characteristic Curve**



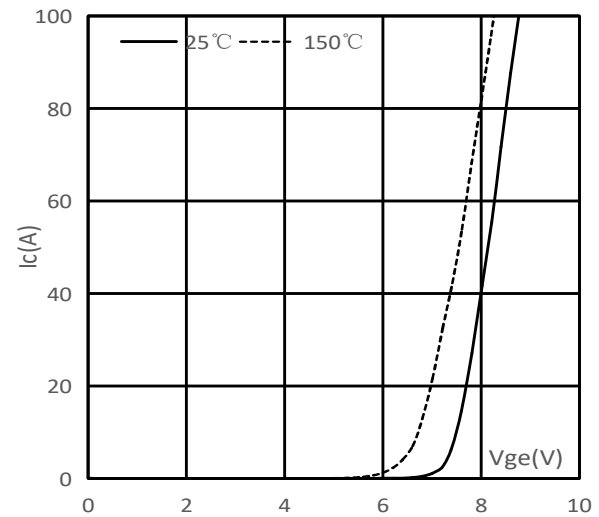
$P_{tot}$  as a function of case Temperature



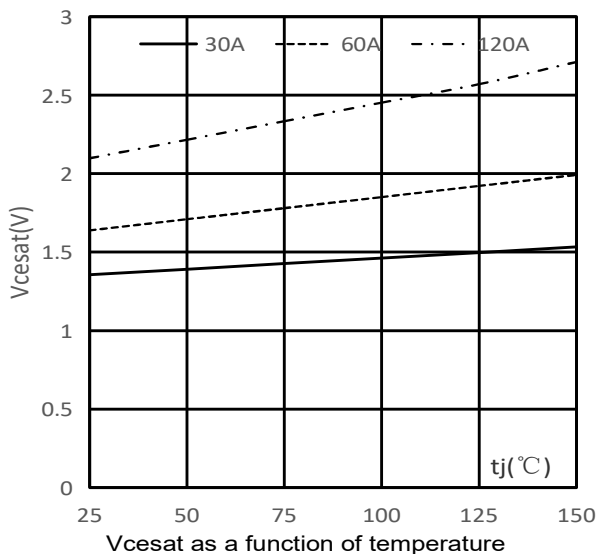
Typical Output Characteristic\_25°C



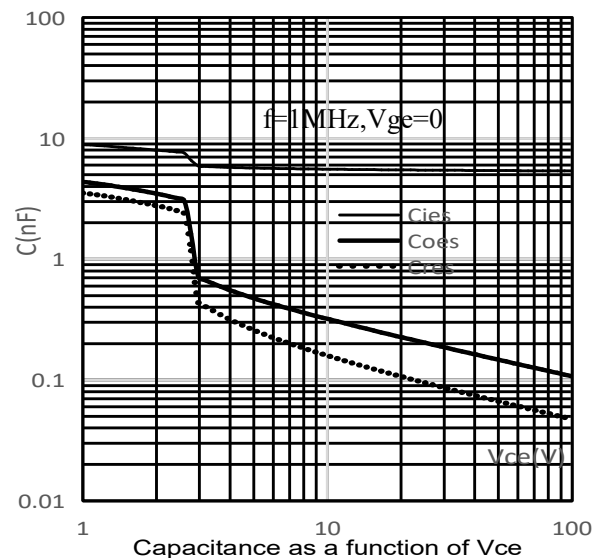
Typical Output Characteristic\_150°C



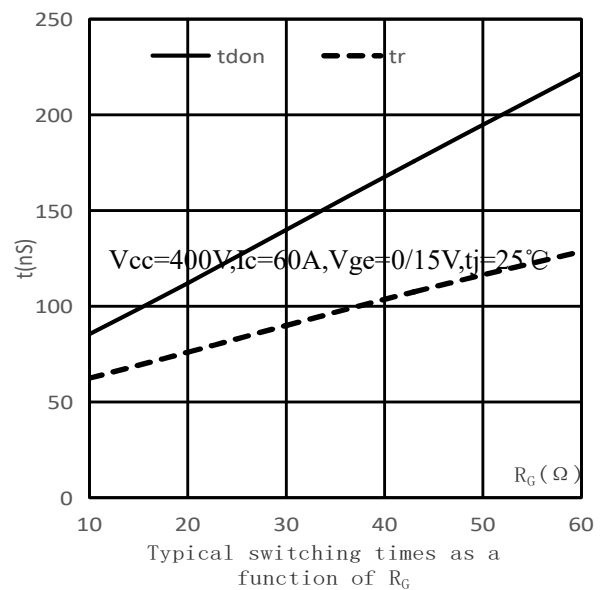
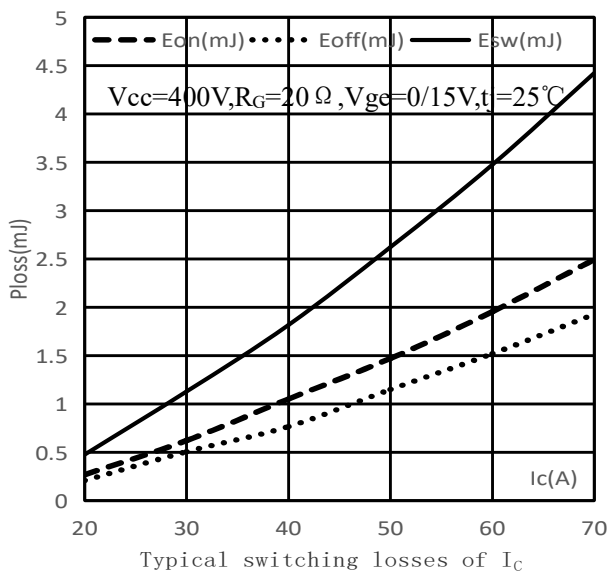
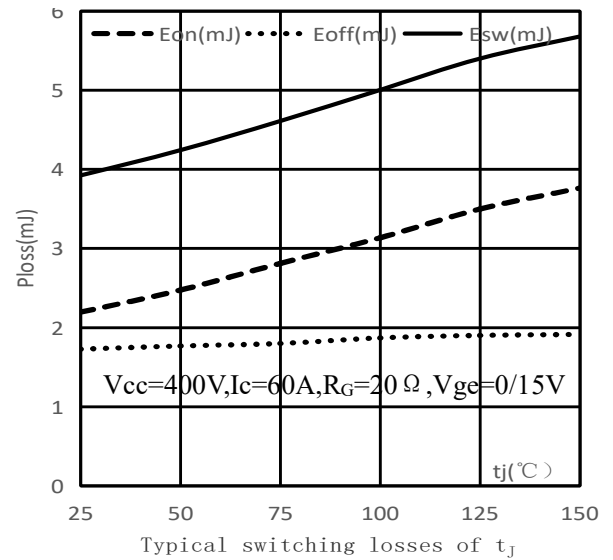
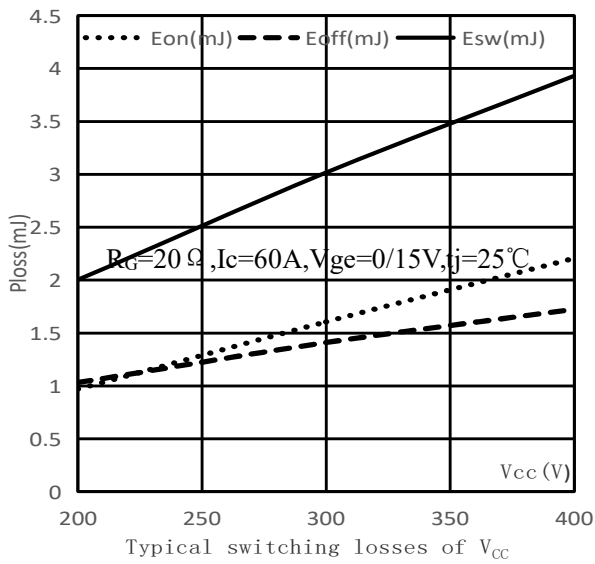
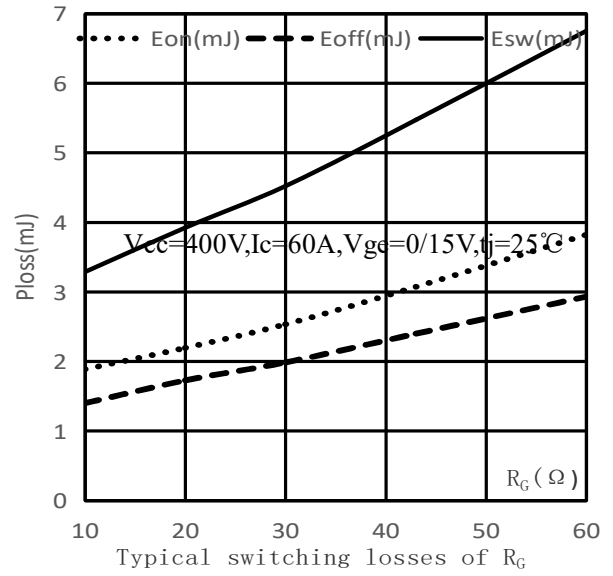
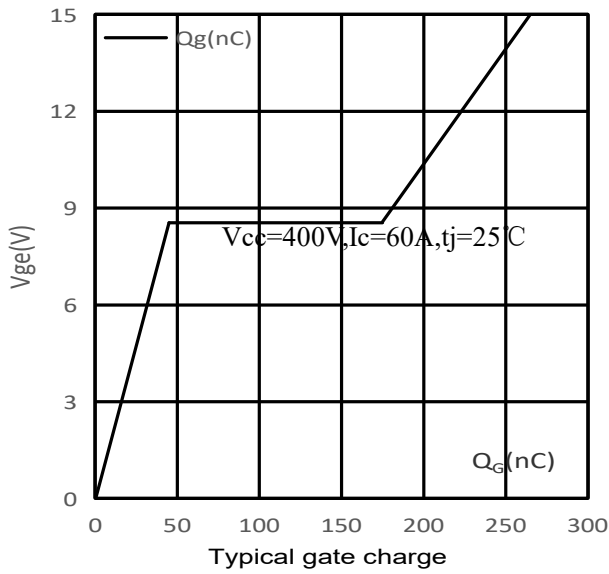
Typical Output Characteristic

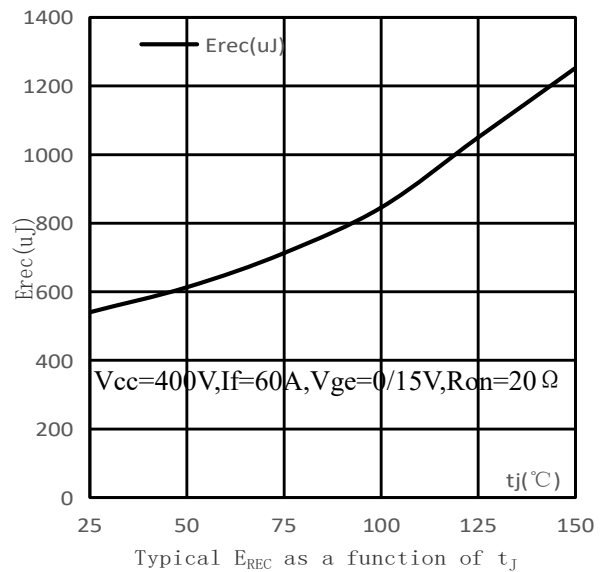
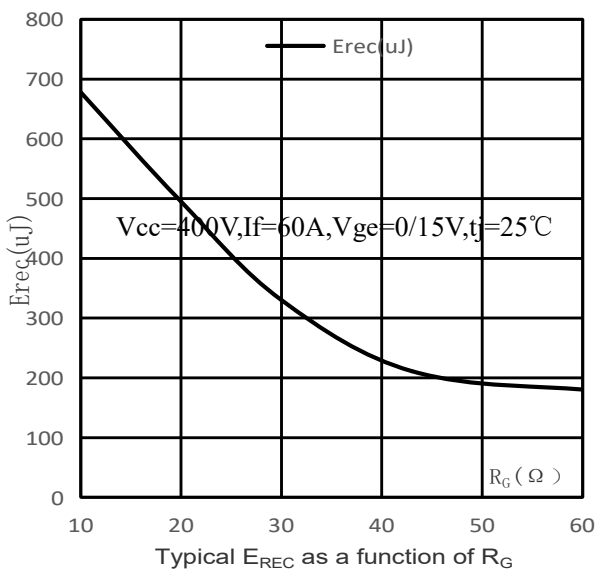
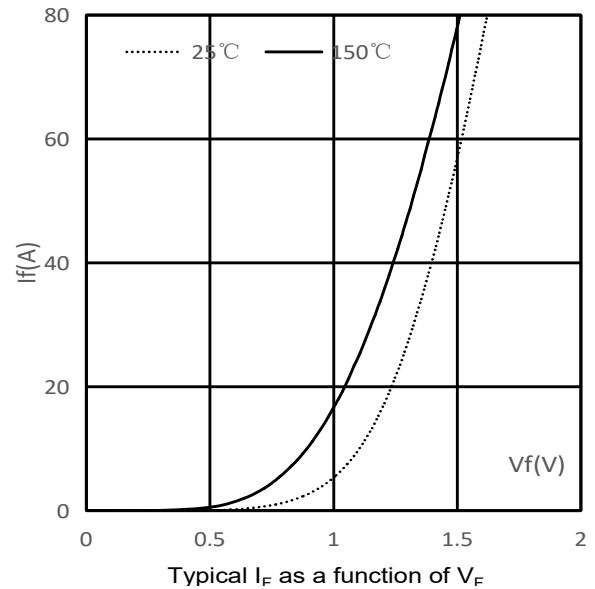
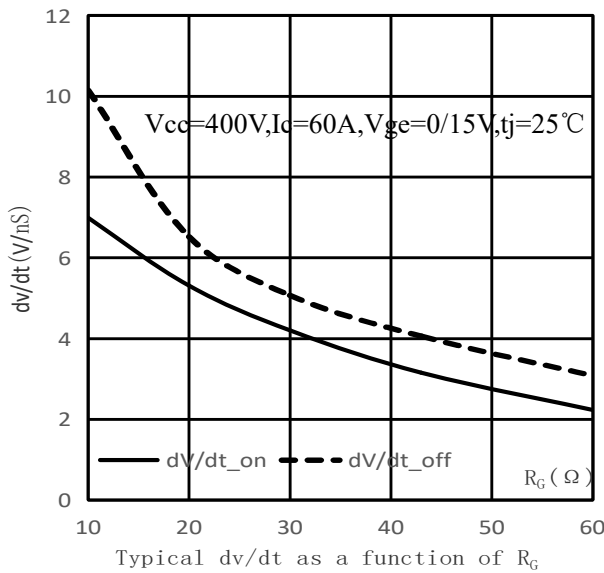
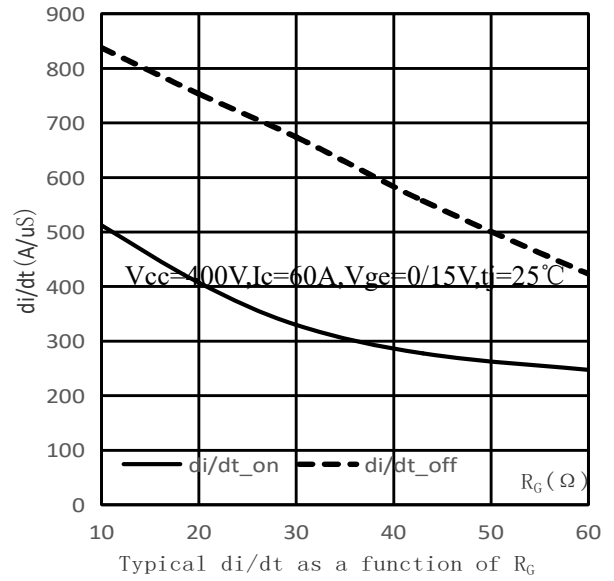
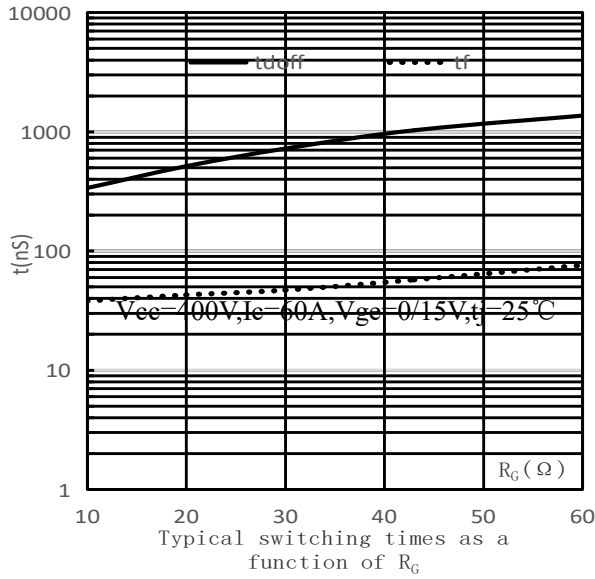


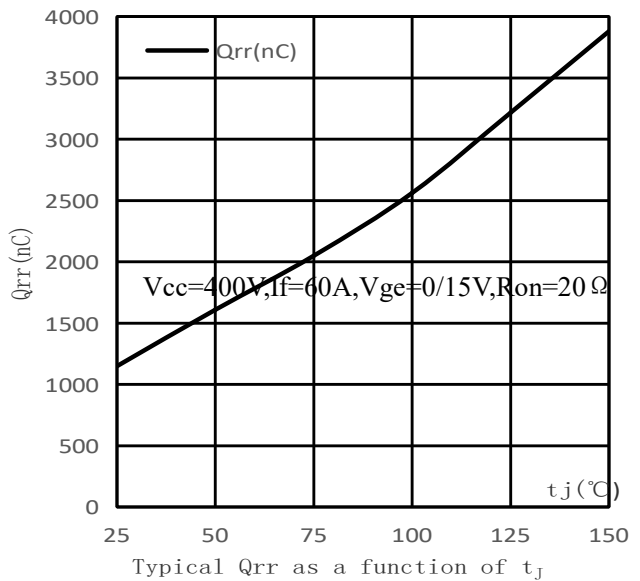
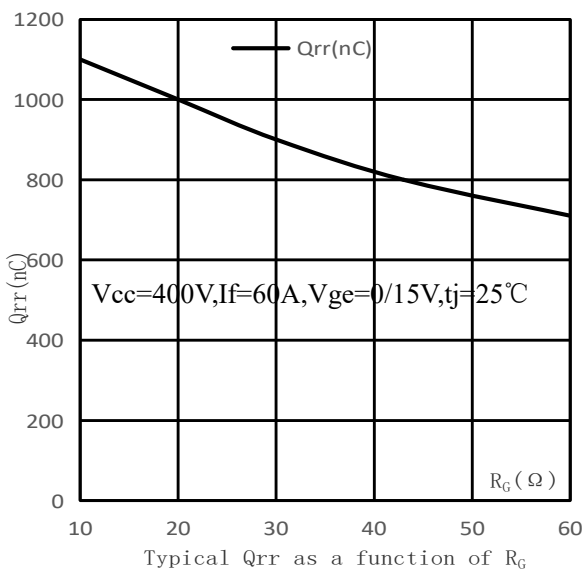
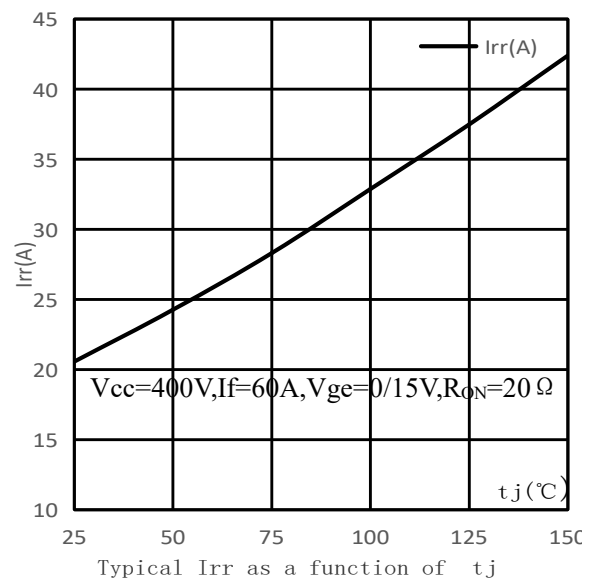
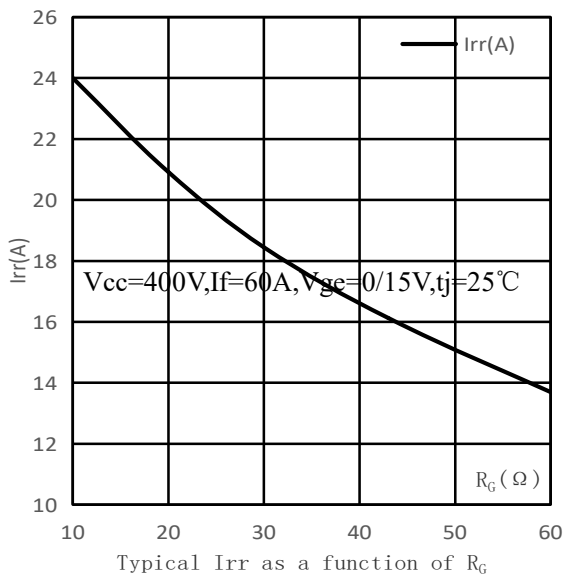
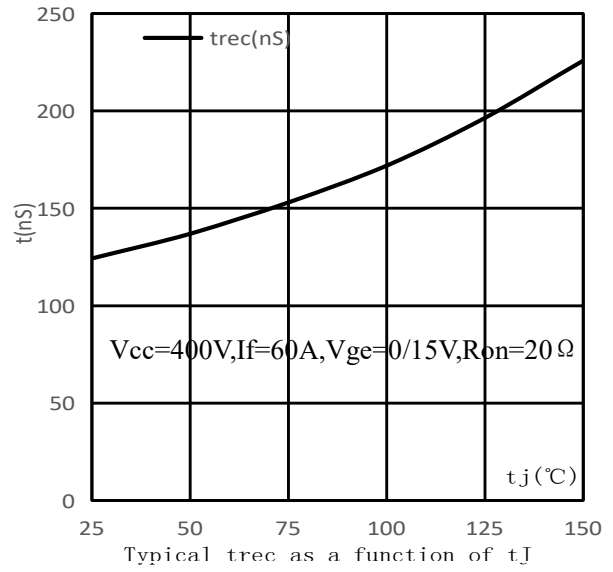
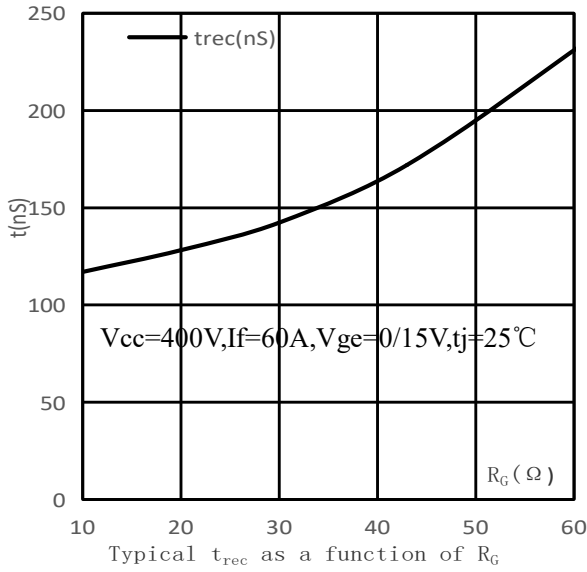
$V_{cesat}$  as a function of temperature



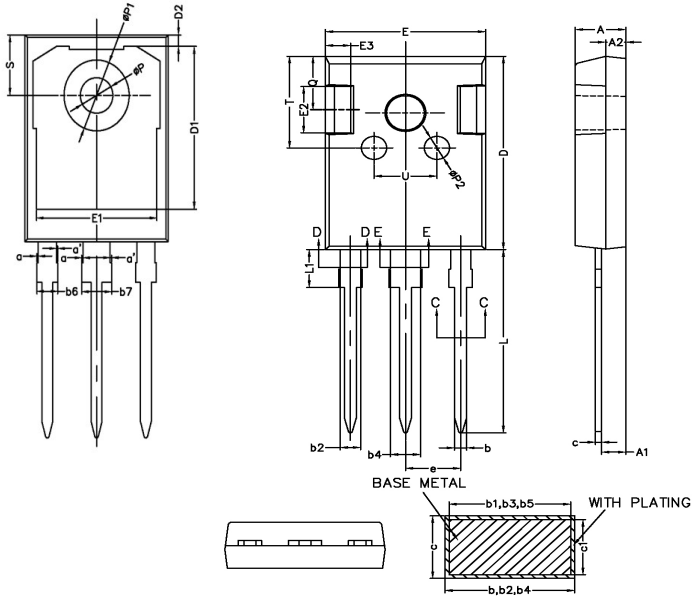
Capacitance as a function of  $V_{ce}$







■ TO-247 Package Outline Data



Unit:mm

SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0	—	0.15
a'	0	—	0.15
b	1.16	—	1.26
b1	1.15	1.2	—
b2	1.96	—	2.06
b3	1.95	2.00	2.02
b4	2.96	—	3.06
b5	2.95	3.00	3.02
b6	—	—	2.25
b7	—	—	3.25
c	0.59	—	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.20	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.90	5.00	5.10
E3	2.40	2.50	2.60
e	5.34	5.44	5.54
L	19.80	19.92	20.10
L1	—	—	4.30
P	3.50	3.60	3.70
P1	—	—	7.40
P2	2.40	2.50	2.60
Q	5.60	—	6.00
S	6.05	6.15	6.25
T	9.80	—	10.20
U	6.00	—	6.40