

Trench-FS Cool-Watt® II IGBT



1. Applications

Inverter power supply
Industrial welding

2. Features

CoolWatt® II Trench-FS technology

Low V_{CESAT}

Low switching losses

With anti-parallel fast recovery diode

Positive temperature coefficient

High reliability

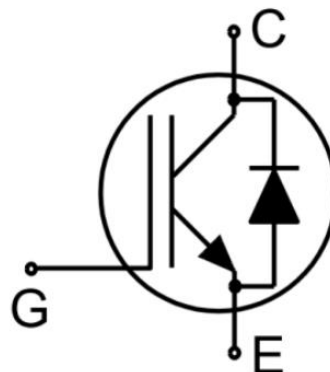
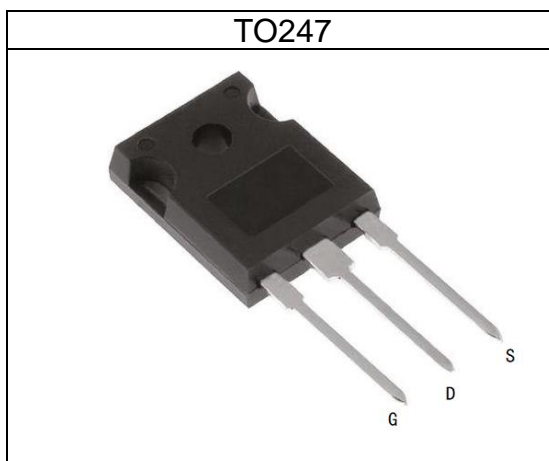


Table 1 Key Performance Parameters

Parameter	Value	Unit
V_{CES}	650	V
$V_{CE(sat)}$	1.4	V
$V_{GE(th)}$	5.45	V
$Q_{g,typ}$	254	nC
I_{Cpuls}	180	A

3. Packaging and Internal Circuit

Part Name	Package	Marking
AGW60N65	TO247	AGW60N65



1 Maximum ratings

at $T_j = 25^\circ\text{C}$, unless otherwise specified

Table 2 Maximum ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector-emitter voltage	V_{CES}	650	-	-	V	$T_C=25^\circ\text{C}$
DC collector current	I_C		-	120	A	$T_C=25^\circ\text{C}$
			-	60	A	$T_C=100^\circ\text{C}$
Pulse collector current	I_{Cpuls}	-	-	180	A	$T_{vj} \leq 150^\circ\text{C}$
Repetitive peak reverse voltage	V_{RRM}	650	-		V	$T_C=25^\circ\text{C}$
Diode continuous forward current	I_F	-	-	120	A	$T_C=25^\circ\text{C}$
		-	-	60	A	$T_C=100^\circ\text{C}$
Diode pulse current	I_{Fpuls}	-	-	180	A	$T_{vj} \leq 150^\circ\text{C}$
Gate-emitter voltage	V_{GE}	-20	-	20	V	static;
		-30	-	30	V	Transient ($t_p \leq 10\mu\text{s}, D < 0.01$)
Power dissipation	P_{tot}	-	-	375	W	$T_C=25^\circ\text{C}$
Storage temperature	T_{stg}	-50	-	150	$^\circ\text{C}$	
Operating junction temperature	T_j	-40	-	175	$^\circ\text{C}$	
Soldering Temperature Distance of 1.6mm from case for 10s	T_L			260	$^\circ\text{C}$	

2 Thermal characteristics

Table 3 Thermal characteristics

Parameter		Symbol	Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
IGBT thermal resistance junction	- case	$R_{thJC-IGBT}$	-	-	0.40	K/W	-
FRD thermal resistance junction	- case	$R_{thJC-FRD}$	-	-	0.90	K/W	-
Thermal resistance junction	- ambient	R_{thJA}	-	-	40	K/W	-

3 Electrical characteristics

at $T_j=25^\circ\text{C}$, unless otherwise specified

Table 4 Static characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Collector-emitter breakdown voltage	$V_{(BR)CES}$	650	-	-	V	$V_{GE} = 0V, I_C=0.5mA, T_{vj}=25^\circ\text{C}$
Collector-emitter saturation voltage	$V_{CE(sat)}$	-	1.4	2	V	$V_{GE}=15V, I_C=30A, T_{vj}=25^\circ\text{C}$
		-	1.95	-	V	$V_{GE}=15V, I_C=30A, T_{vj}=150^\circ\text{C}$
Gate-emitter threshold voltage	$V_{GE(th)}$	5.05	5.45	5.85	V	$V_{GE}= V_{CE}, I_C=1.5mA, T_{vj}=25^\circ\text{C}$
Diode forward voltage	V_F	-	1.75	2.15	V	$V_{GE}= 0V, I_F=30A, T_{vj}=25^\circ\text{C}$
		-	1.65	-	V	$V_{GE}= 0V, I_F=30A, T_{vj}=150^\circ\text{C}$
Zero collector voltage gate current	I_{GES}	-	-	200	nA	$V_{GE}=30V, V_{CE}=0V$
Zero gate voltage collector current	I_{CES}	-	-	0.5	mA	$V_{CE} =650V, V_{GE}=0V, T_{vj}=25^\circ\text{C}$
		-	-	1.0	mA	$V_{CE} =650V, V_{GE}=0V, T_{vj}=150^\circ\text{C}$
Integrated gate resistor	R_{Gin}	—	0	—	Ω	—

Table 5 Dynamic characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input capacitance	C_{ies}	-	6920	-	pF	$V_{GE} = 0V, V_{CE}= 30V, f = 1MHz, T_{vj}=25^\circ\text{C}$
Output capacitance	C_{oes}	-	199	-	pF	$V_{GE} = 0V, V_{CE}= 30V, f = 1MHz, T_{vj}=25^\circ\text{C}$
Reverse transfer capacitance	C_{res}	-	88	-	pF	$V_{GE} = 0V, V_{CE}= 30V, f = 1MHz, T_{vj}=25^\circ\text{C}$
Gate charge	Q_g	-	254	-	nC	$V_{GE}=0/15V, V_{cc}=520V, I_C=60A, T_{vj}=25^\circ\text{C}$
Gate-emitter charge	Q_{ge}	-	40.2	-	nC	$V_{GE}=0/15V, V_{cc}=520V, I_C=60A, T_{vj}=25^\circ\text{C}$
Gate-collector charge	Q_{gc}	-	132	-	nC	$V_{GE}=0/15V, V_{cc}=520V, I_C=60A, T_{vj}=25^\circ\text{C}$
Gate-emitter plateau voltage	$V_{GE(pl)}$	-	8.80	-	V	$I_C =60A, V_{CE}=520V, V_{GE}=0/15V, T_{vj}=25^\circ\text{C}$

Table 6 Switching characteristics

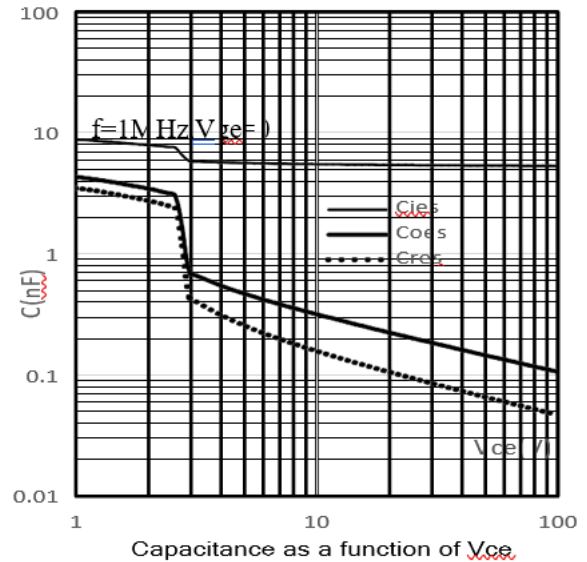
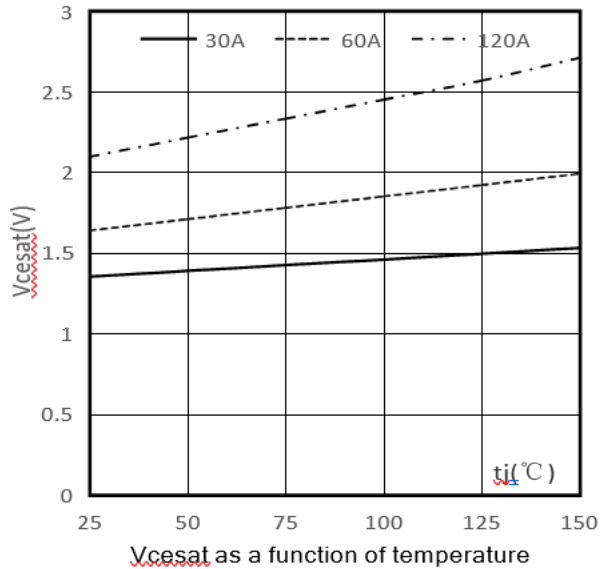
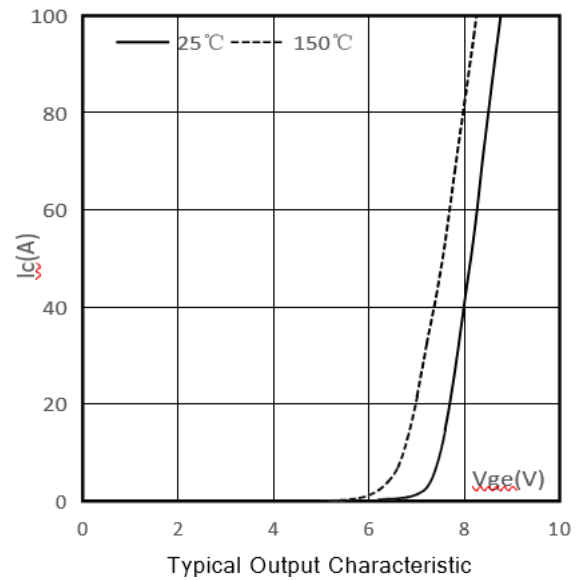
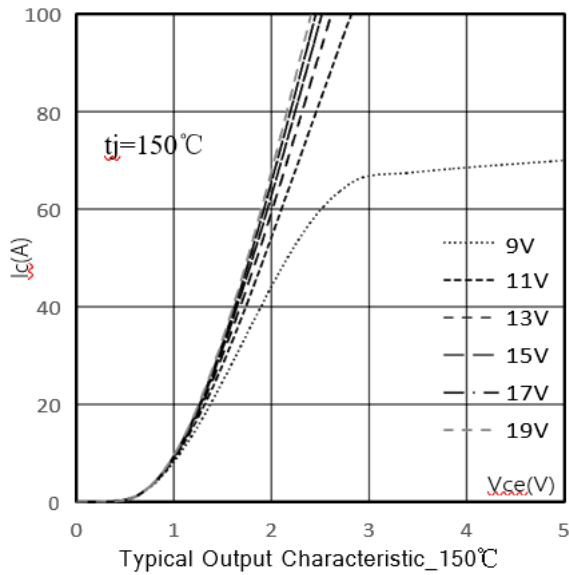
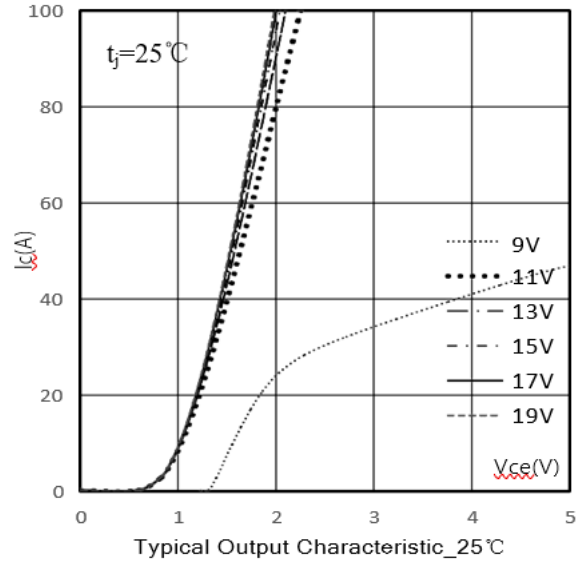
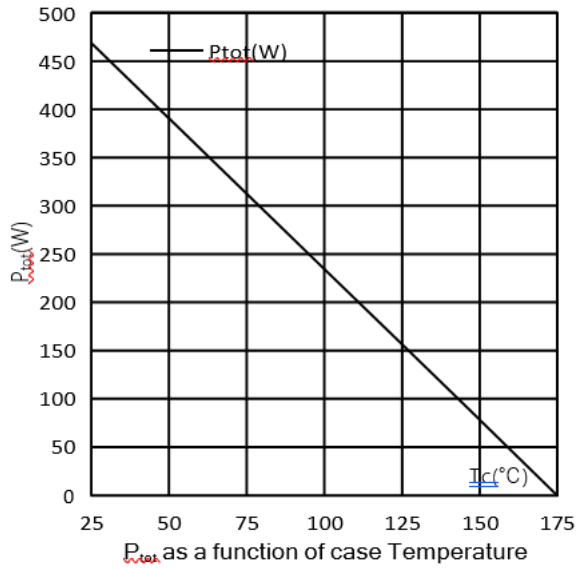
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Turn-on delay time	$T_{d(on)}$	—	125	—	ns	$V_{cc}=400V, I_c=60A,$ $R_{on}=20\ \Omega, R_{off}=20\ \Omega,$ $C_{ge}=0nF, V_{GE}=0/15V,$ $L_{load}=100\mu H, T_{vj}=25^\circ C$
Rise time	T_r	—	136	—	ns	
Turn-off delay time	$T_{d(off)}$	—	540	—	ns	
Fall time	t_f	—	71	—	ns	
Turn-on energy	E_{on}	—	2.38	—	mJ	
Turn-off energy	E_{off}	—	2.13	—	mJ	
Total switch energy	E_{total}	—	4.51	—	mJ	

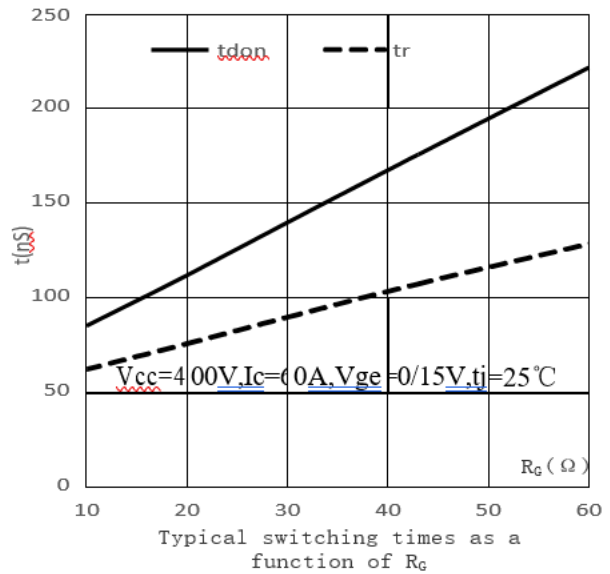
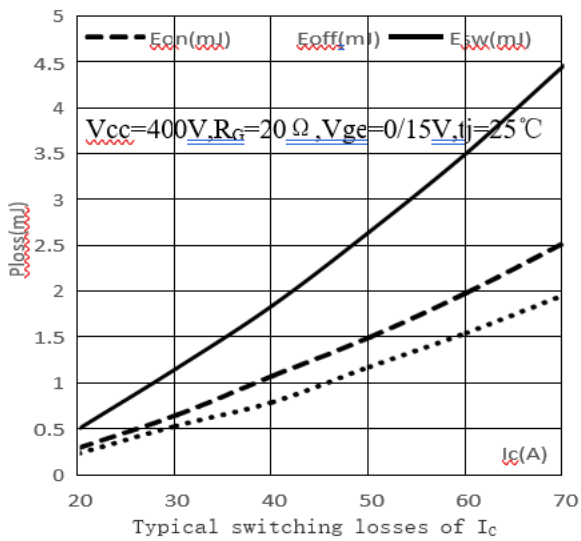
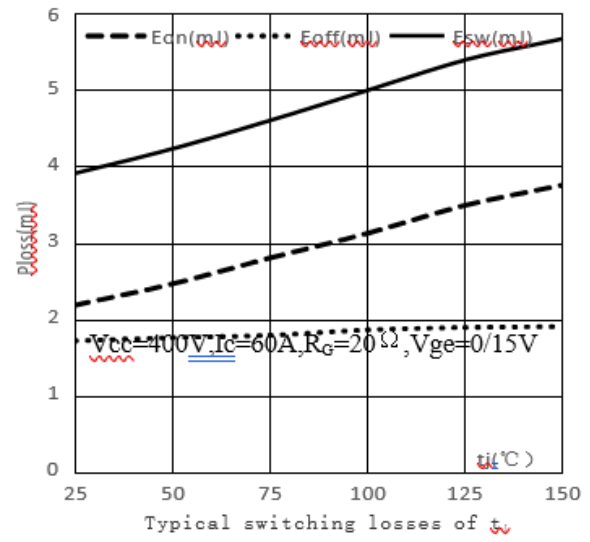
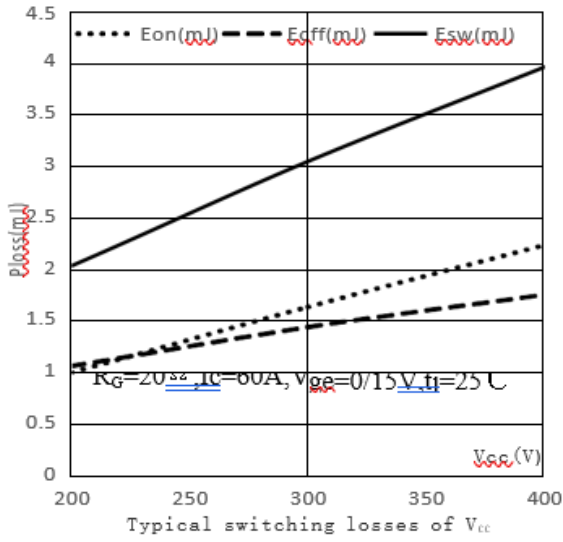
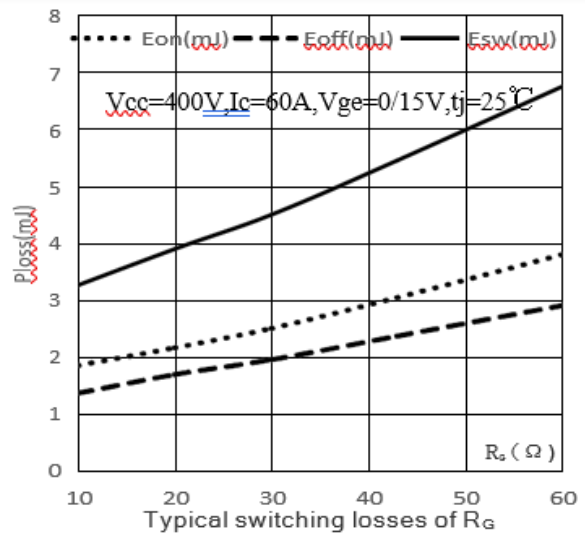
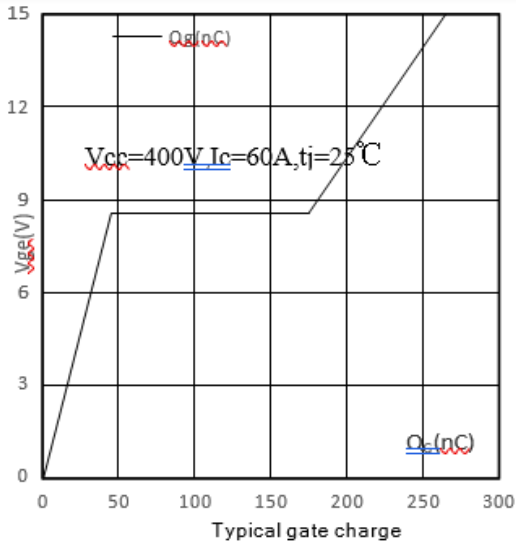
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Turn-on delay time	$T_{d(on)}$	—	113	—	ns	$V_{cc}=400V, I_c=60A,$ $R_{on}=20\ \Omega, R_{off}=20\ \Omega,$ $C_{ge}=0nF, V_{GE}=0/15V,$ $L_{load}=100\mu H, T_{vj}=150^\circ C$
Rise time	T_r	—	135	—	ns	
Turn-off delay time	$T_{d(off)}$	—	612	—	ns	
Fall time	t_f	—	86	—	ns	
Turn-on energy	E_{on}	—	3.10	—	mJ	
Turn-off energy	E_{off}	—	2.64	—	mJ	
Total switch energy	E_{total}	—	5.74	—	mJ	

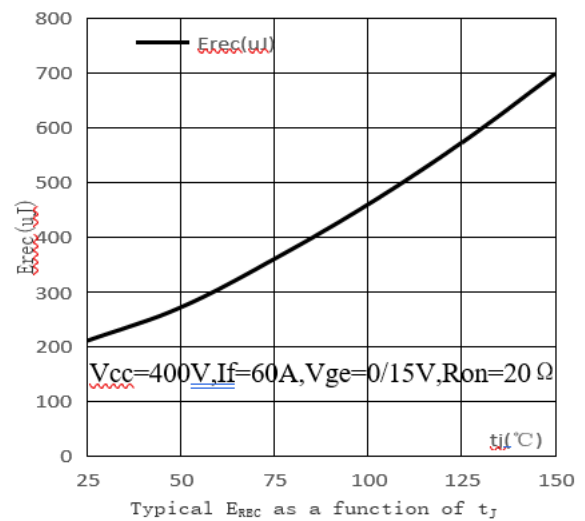
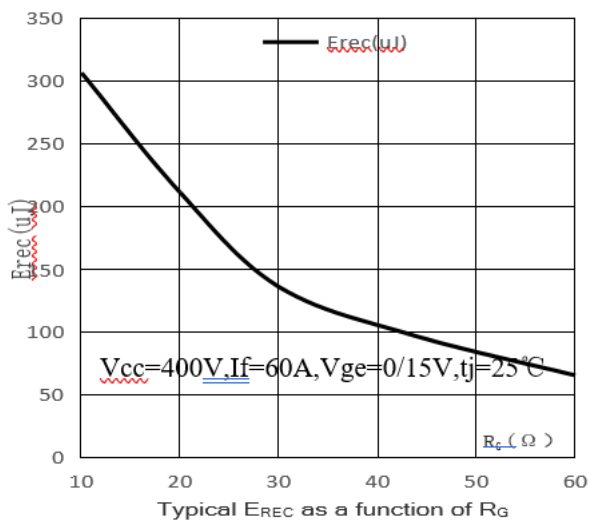
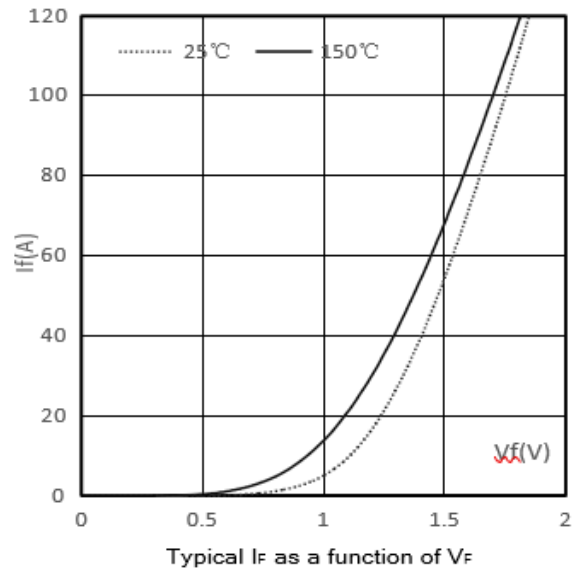
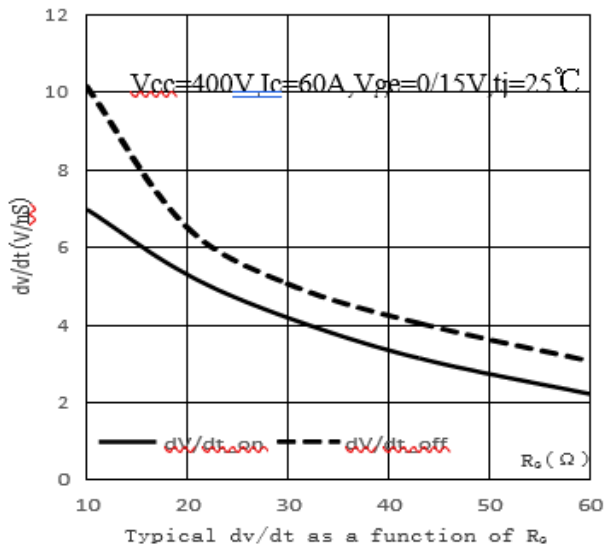
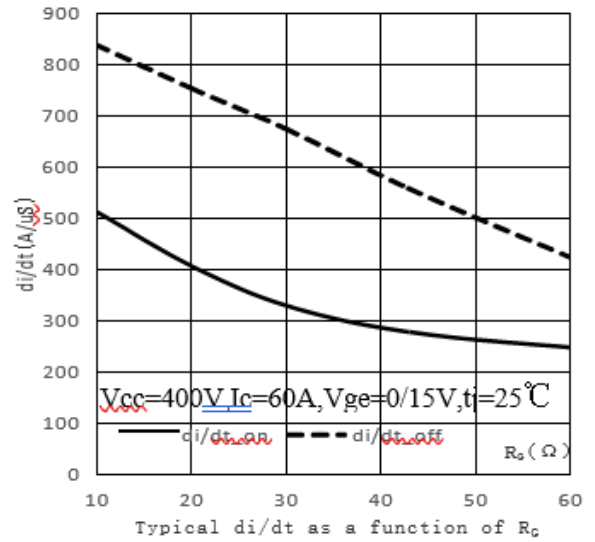
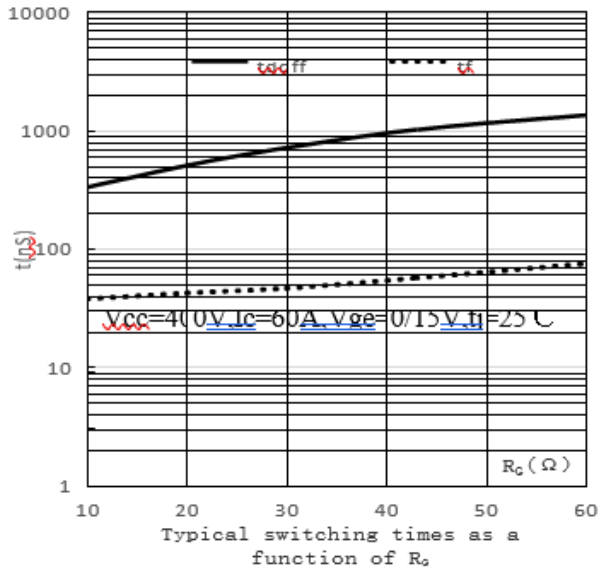
Table 7 Diode characteristics

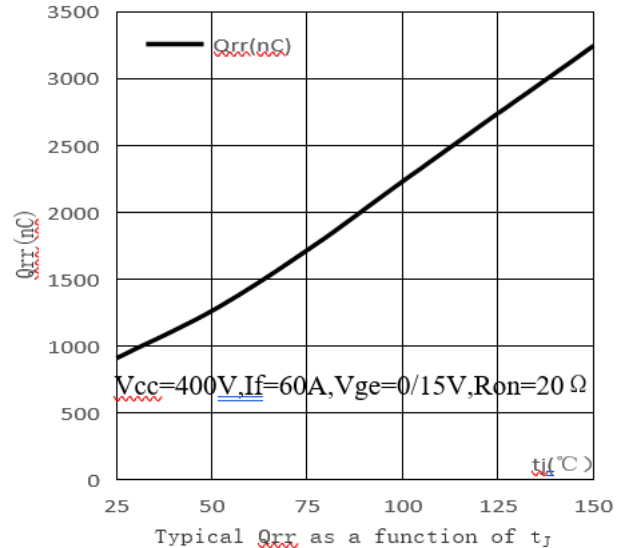
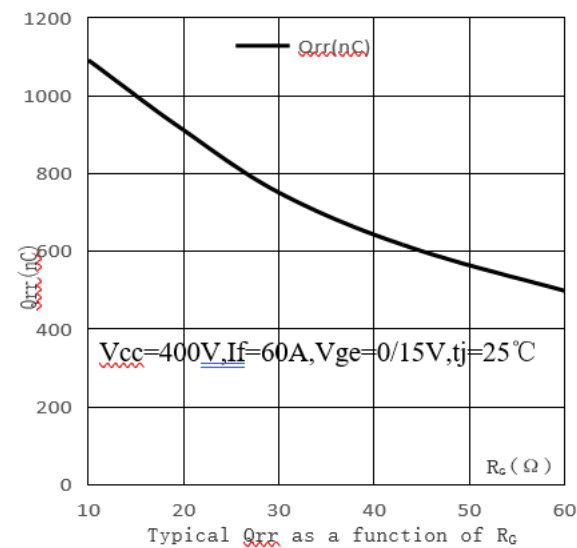
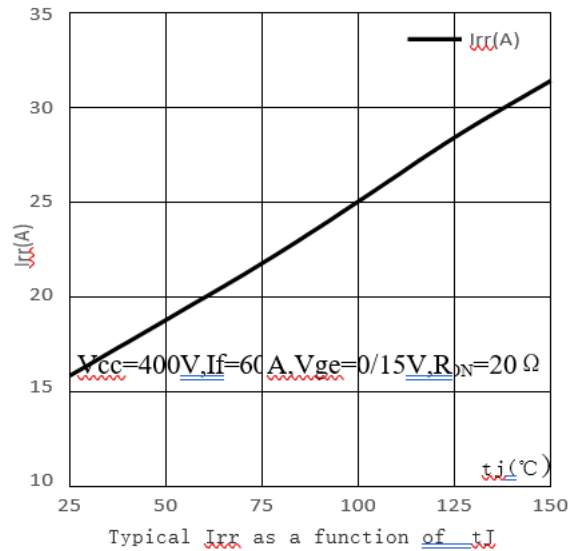
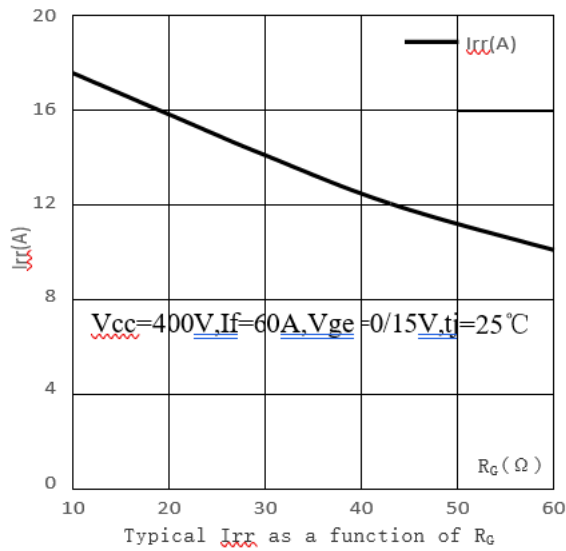
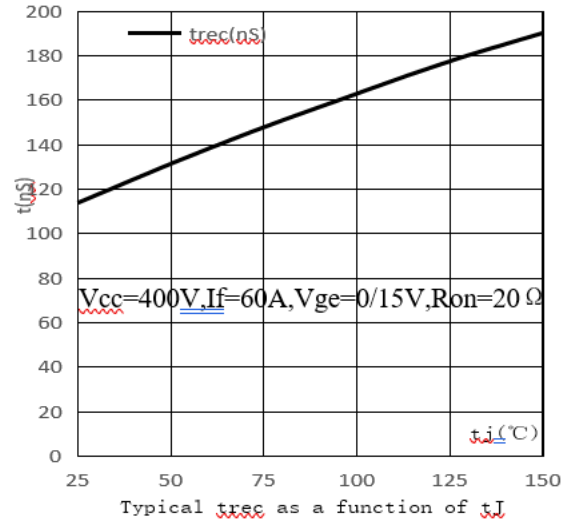
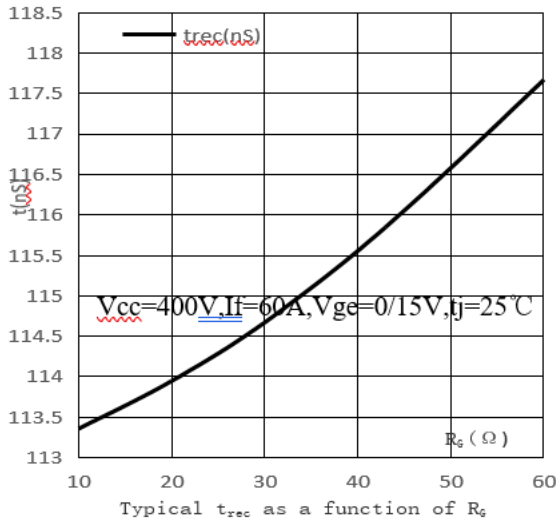
Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Reverse recovery energy	Erec	—	137	—	uJ	I _F =30A, V _R =400V, V _{GE} =0/15V, R _{ON} =20 Ω, T _{vj} =25°C
Diode reverse recovery time	t _{rr}	—	96	—	nS	
Diode reverse recovery charge	Q _{rr}	—	562	—	nC	
Diode peak reverse recovery current	I _{rrm}	—	11.6	—	A	
Diode peak rate of fall of reverse Recovery current during t _{rr}	d _{irr} /dt	—	217	—	A/uS	
Parameter	Symbol	Values			Unit	
		Min.	Typ.	Max.		
Reverse recovery energy	Erec	—	323	—	uJ	I _F =30A, V _R =400V, V _{GE} =0/15V, R _{ON} =20 Ω, T _{vj} =150°C
Diode reverse recovery time	t _{rr}	—	121	—	nS	
Diode reverse recovery charge	Q _{rr}	—	1567	—	nC	
Diode peak reverse recovery current	I _{rrm}	—	19.4	—	A	
Diode peak rate of fall of reverse Recovery current during t _{rr}	d _{irr} /dt	—	154	—	A/uS	

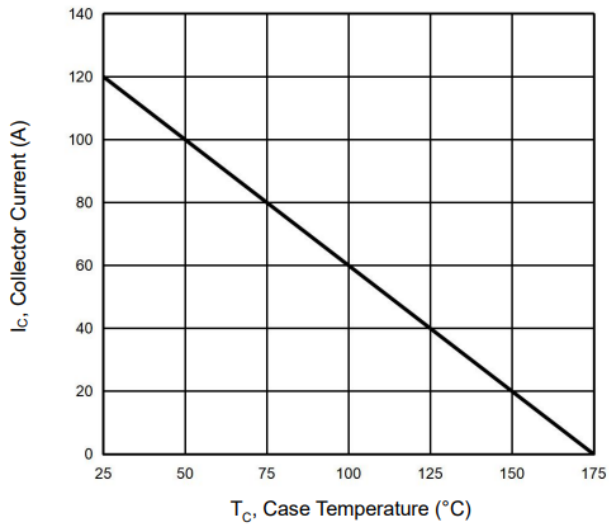
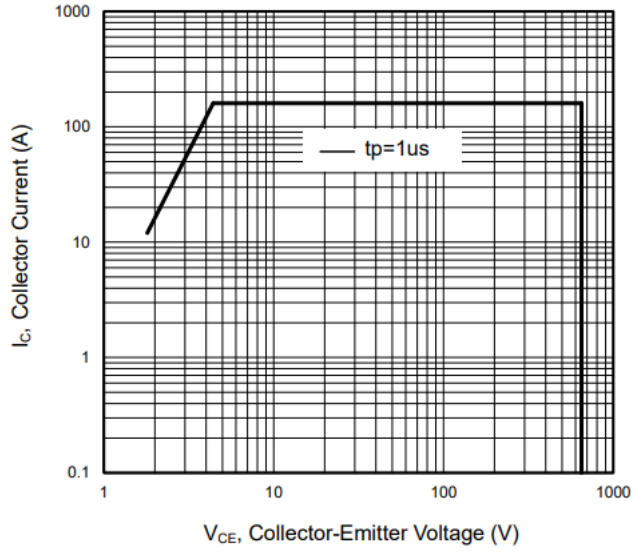
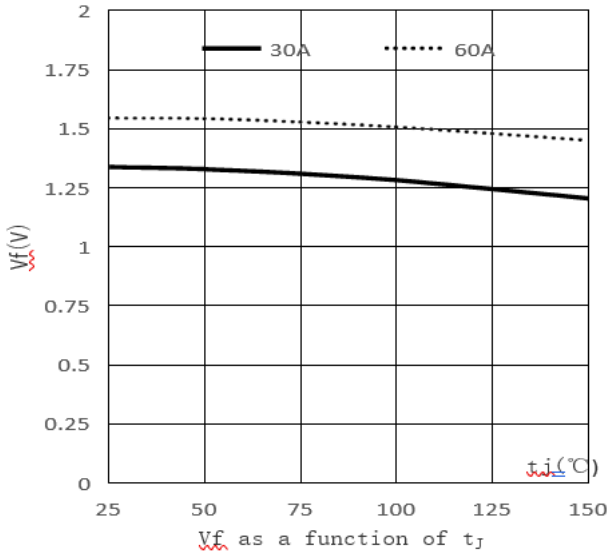
4 Electrical characteristics diagram





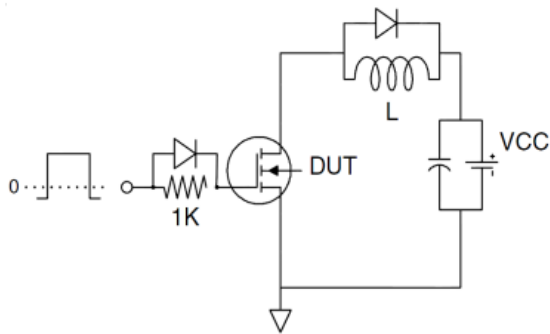




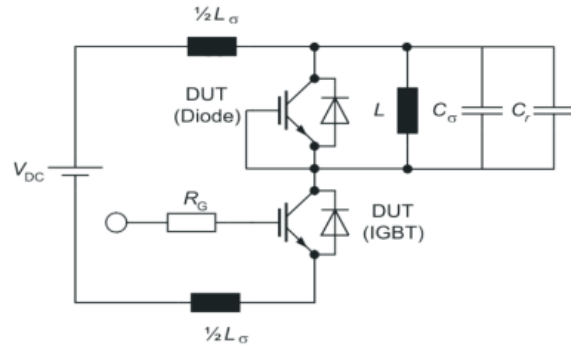


5 Test Circuits

1) Gate Charge Test Circuit

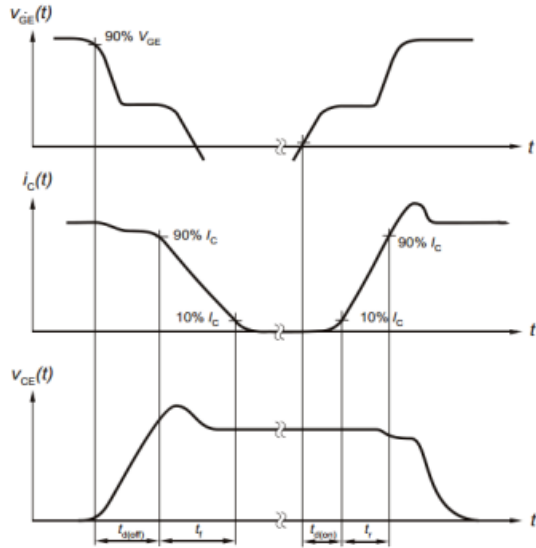


2) Switch Time Test Circuit

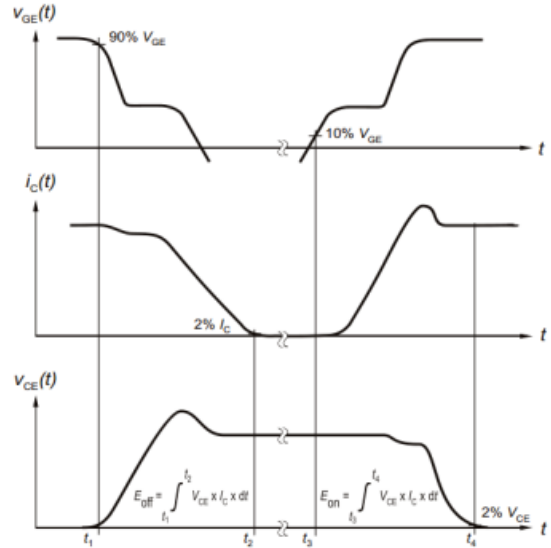


Switching characteristics

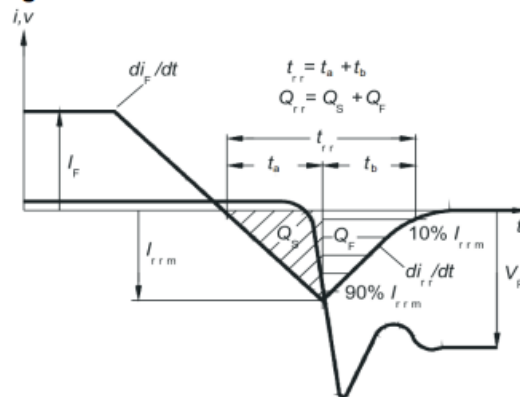
1) definition of switching times



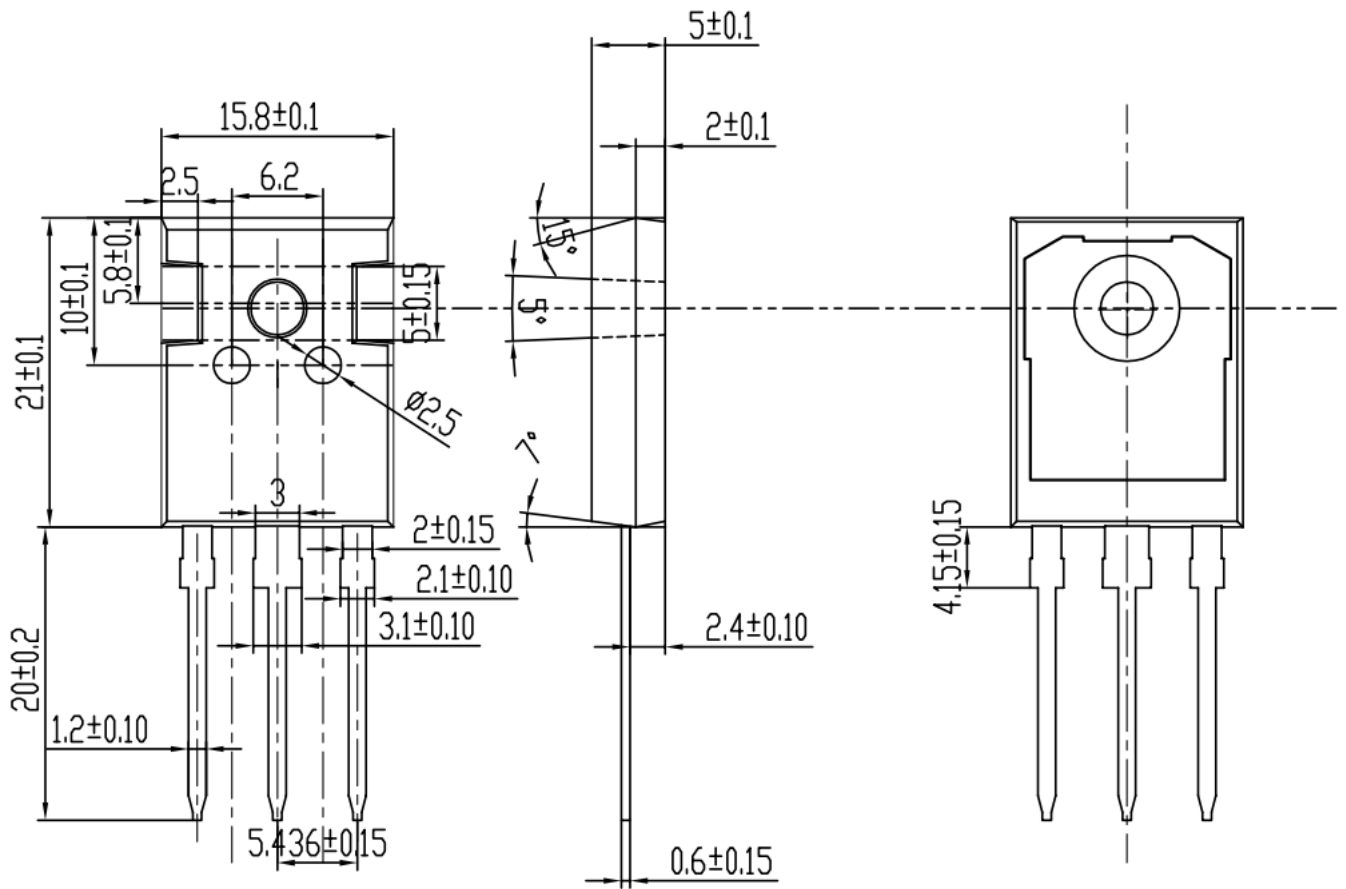
2) definition of switching losses



3) Definition of diode switching characteristics



6 Package Outlines



Outline PG-TO247(HT)

Revision History

Revision	Date	Subjects (major changes since last revision)
1.0	2023-02-28	Preliminary version

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