



**TO-3PN Plastic-Encapsulate IGBT**

**CCGA40T65HD**

IGBT in Trench FS Technology

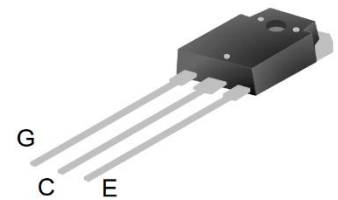
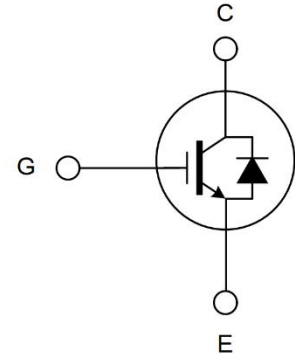
$V_{(BR)CES}$	$V_{CEsat}$		$I_c$	
650V	$T_{vj}=25^{\circ}C$	1.50V@40A	$T_{vj}=25^{\circ}C$	80A
	$T_{vj}=150^{\circ}C$	1.75V@40A	$T_{vj}=150^{\circ}C$	40A

**Features:**

- 650V Trench field-stop technology
- Low conduction and switching losses
- Positive temperature coefficient of forward voltage
- Short Circuit withstand time-10 $\mu$ s
- AEC Q101 qualified

**Applications:**

- Automobile PTC
- Short-Circuit Protector
- UPS Power
- Electric Welding Machine



TO-3PN

**Key Performance and Package Parameters**

Type	$V_{CE}$	$I_c$	$V_{CEsat}$ $T_{vj}=25^{\circ}C@40A$	$T_{vjmax}$	Marking	Package
CCGA40T65HD	650V	40A	1.5V	175 $^{\circ}C$	CCGA40T65HD	PG-TO-3PN

### Maximum Rated Values

Parameter	Symbol	Value	Unit
Collector emittervoltage	$V_{CE}$	650	V
DC collector current, $T_C=25^{\circ}\text{C}$	$I_C$	80	A
DC collector current, $T_C=100^{\circ}\text{C}$	$I_C$	40	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$	$I_{Cplus}$	160	A
Diode forward current, $T_C=25^{\circ}\text{C}$	$I_F$	40	A
Diode forward current, $T_C=100^{\circ}\text{C}$	$I_F$	20	A
Diode pulsed current, $t_p$ limited by $T_{vjmax}$	$I_{Fplus}$	80	A
Gate emitter voltage	$V_{GE}$	$\pm 30$	V
Short circuit with stand time, $V_{GE}=15\text{V}$ , $V_{CC}=400\text{V}$ , $T_{vj}=175^{\circ}\text{C}$	$t_{SC}$	6	$\mu\text{s}$
Power dissipation , $T_C=25^{\circ}\text{C}$	$P_{tot}$	357	W
Operating junction temperature	$T_{vj}$	-40~+175	$^{\circ}\text{C}$
Storage temperature	$T_{stg}$	-55~+175	$^{\circ}\text{C}$

### Thermal Resistance

Parameter Characteristic	Symbol	Value	Unit
IGBT thermal resistance, junction-case	$R_{thjc}$	0.42	K/W
FRD thermal resistance, junction-case	$R_{thjc}$	1.52	K/W
Thermal resistance junction to ambient	$R_{thja}$	45	K/W

**Static Characteristics,  $T_C=25^\circ\text{C}$ , unless otherwise specified**

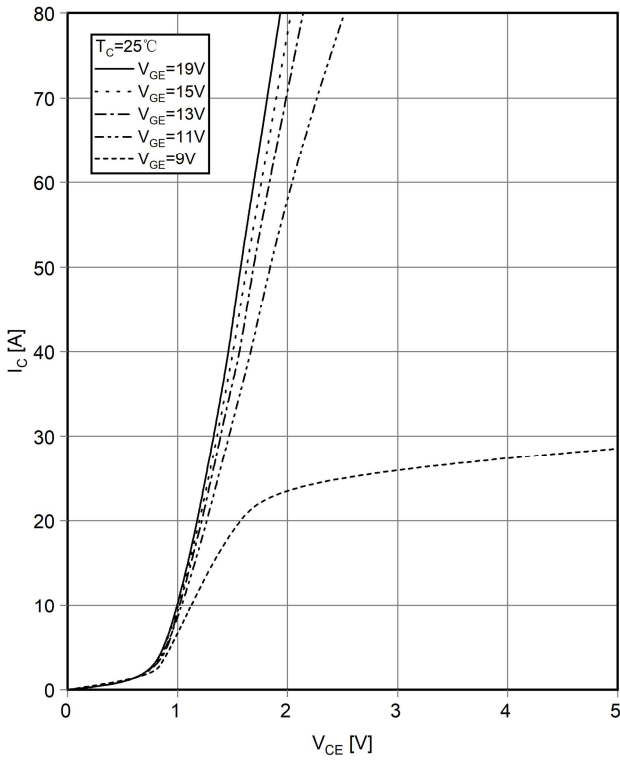
Parameter	Symbol	Conditions	Value			Unit	
			min	typ	max		
Collector emitter break down voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=1mA$	650	-	-	V	
Collector emitter saturation voltage	$V_{CEsat}$	$V_{GE}=15V, I_C=40A$	$T_{vj}=25^\circ\text{C}$	-	1.5	1.9	V
			$T_{vj}=150^\circ\text{C}$	-	1.75		
Diode forward voltage	$V_F$	$V_{GE}=0V, I_F=20A$	$T_{vj}=25^\circ\text{C}$	-	1.7	1.85	V
			$T_{vj}=150^\circ\text{C}$	-	1.4		
Gate emitter threshold voltage	$V_{GEth}$	$I_C=1mA, V_{CE}=V_{GE}$	4.8	5.5	6.2	V	
Zero gate voltage collector current	$I_{CES}$	$V_{CE}=650V, V_{GE}=0V$	-	-	4	$\mu\text{A}$	
Gate emitter leakage current	$I_{GES}$	$V_{CE}=0V, V_{GE}=20V$	-	-	200	nA	

**Switching Characteristic, at  $T_C=25^\circ\text{C}$ , unless otherwise specified**

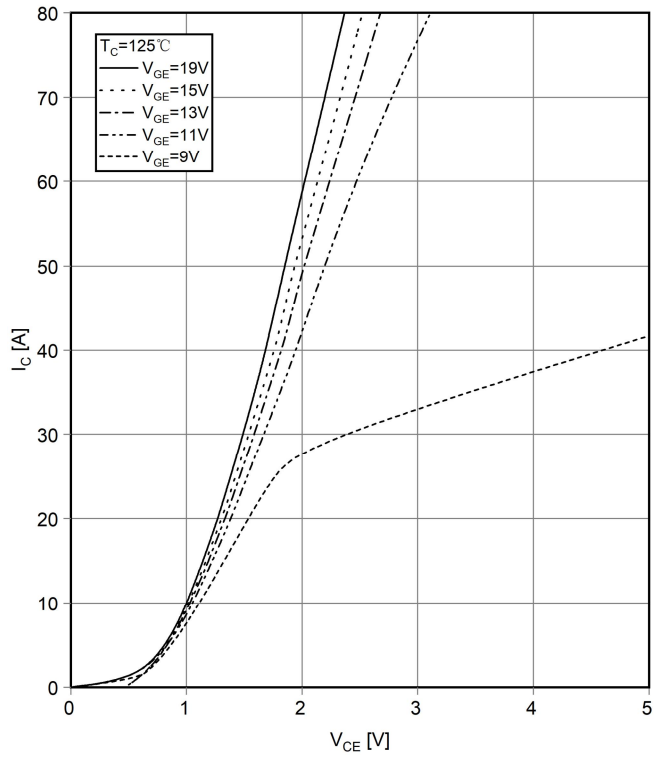
Parameter	Symbol	Conditions	Value			Unit
			min	typ	max	
<b>IGBT Characteristic</b>						
Input capacitance	$C_{ies}$	$V_{CE}=25V, V_{GE}=0V, f=100kHz$	-	2220	-	pF
Output capacitance	$C_{oes}$		-	125	-	
Reverse transfer capacitance	$C_{res}$		-	27	-	
Gate resistance	$R_g$	$f=100kHz$	-	2.9	-	$\Omega$
Turn-on delay time	$t_{d\ on}$	$V_{CE}=400V, V_{GE}=-8V/+15V, R_g=10\Omega, I_C=30A, \text{Inductive Load}$	-	46	-	ns
Rise time	$t_r$		-	154	-	ns
Turn-off delay time	$t_{d\ off}$		-	120	-	ns
Fall time	$t_f$		-	134	-	ns
Turn-on energy	$E_{on}$		-	2.5	-	mJ
Turn-off energy	$E_{off}$		-	1.1	-	mJ
<b>FRD Characteristic</b>						
Reverse recovery time	$t_{rr}$	$V_R=400V, R_g=10\Omega, I_F=20A, \text{Inductive Load}$	-	33	-	ns
Recovery charge	$Q_r$		-	65	-	$\mu\text{C}$
Peak recovery current	$I_{RM}$		-	25	-	A

## Typical Characteristic Curve

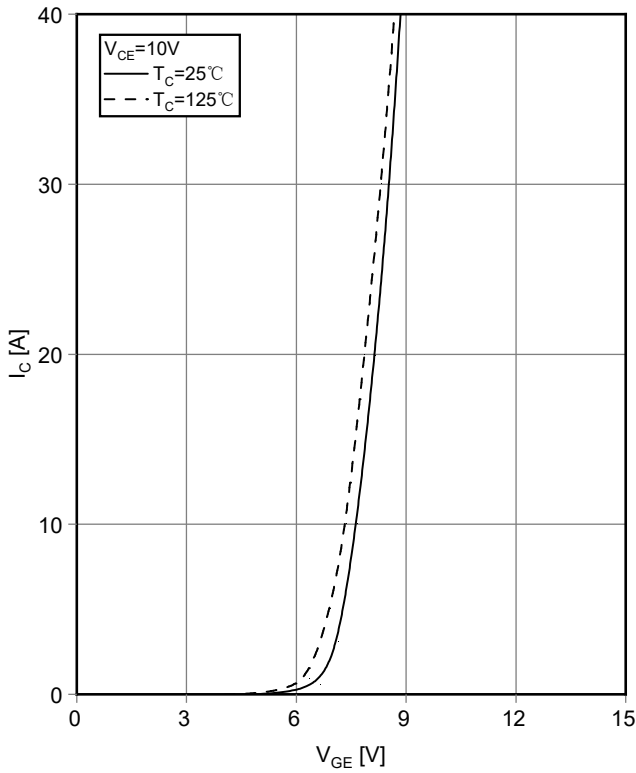
1. Typical output characteristic ( $T_C=25^\circ\text{C}$ )



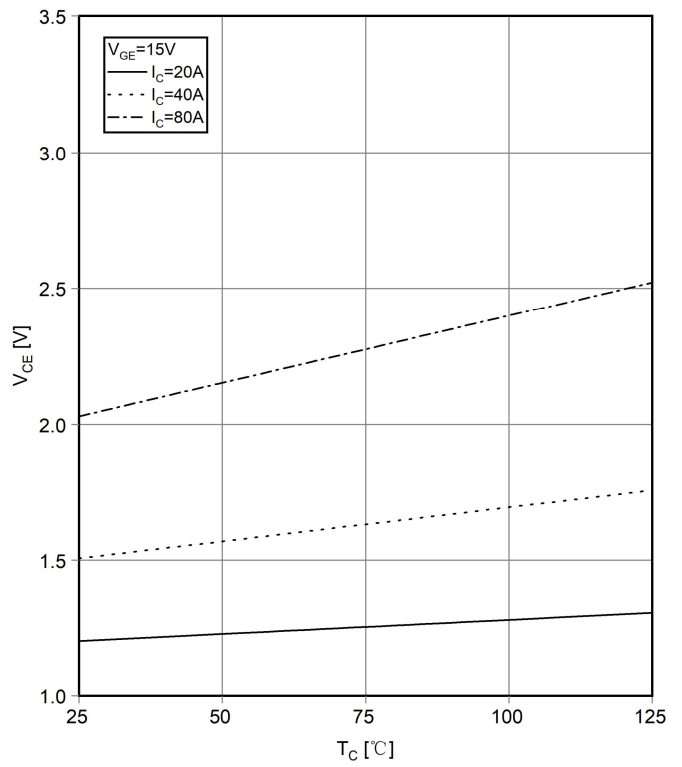
2. Typical output characteristic ( $T_C=125^\circ\text{C}$ )



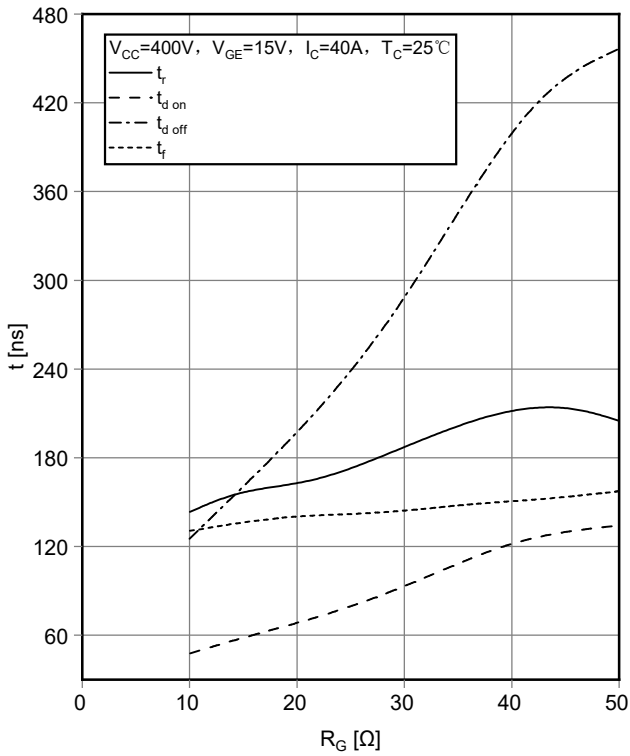
3. Typical transfer characteristic



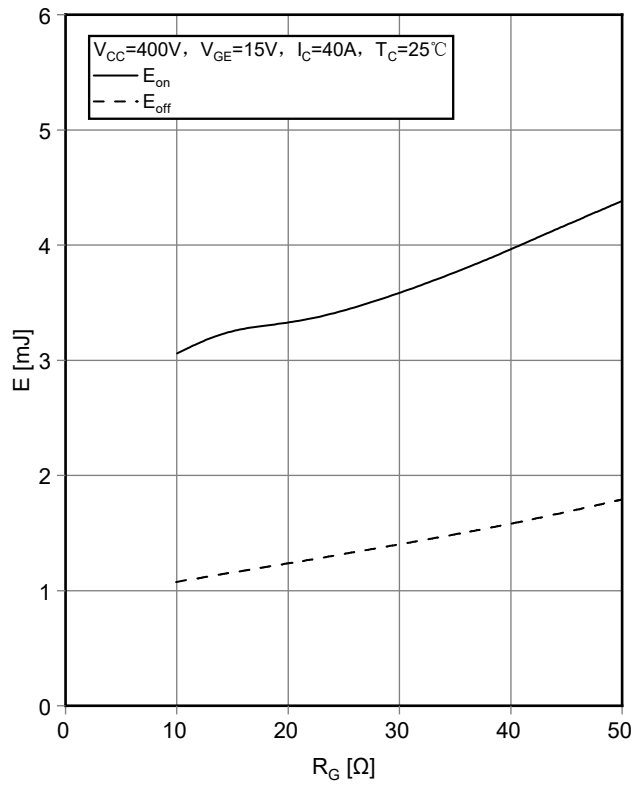
4. Typical collector-emitter saturation voltage as a function of case temperature



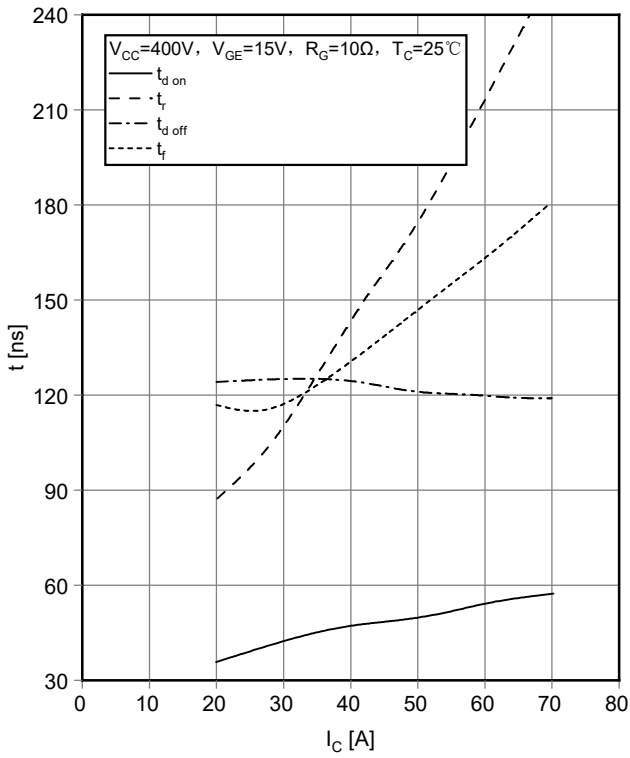
5. Typical switching times as a function of gate resistor



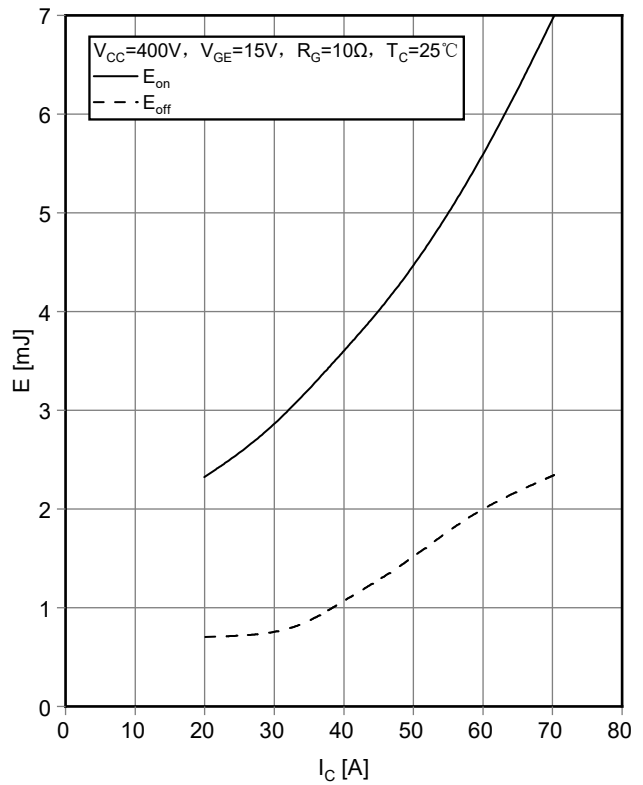
6. Typical switching energy losses as a function of gate resistor



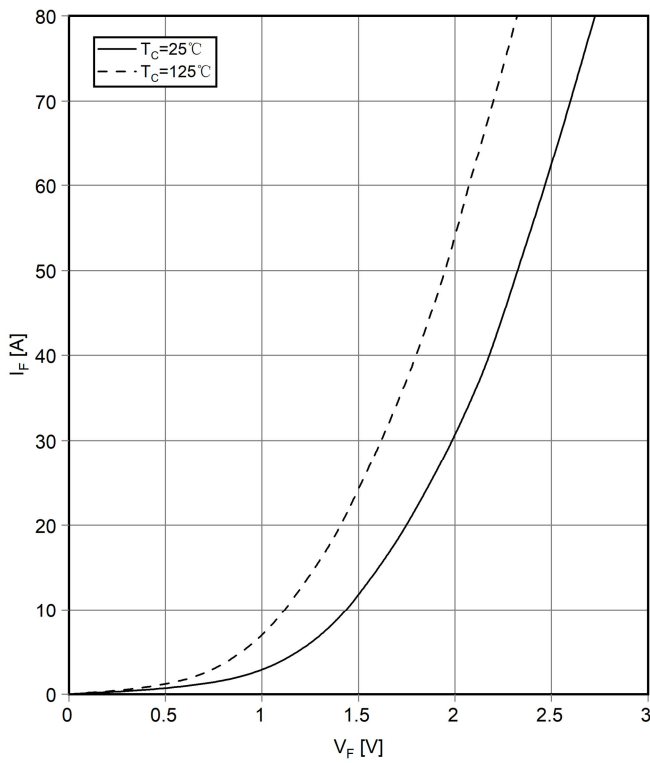
7. Typical switching times as a function of collector current



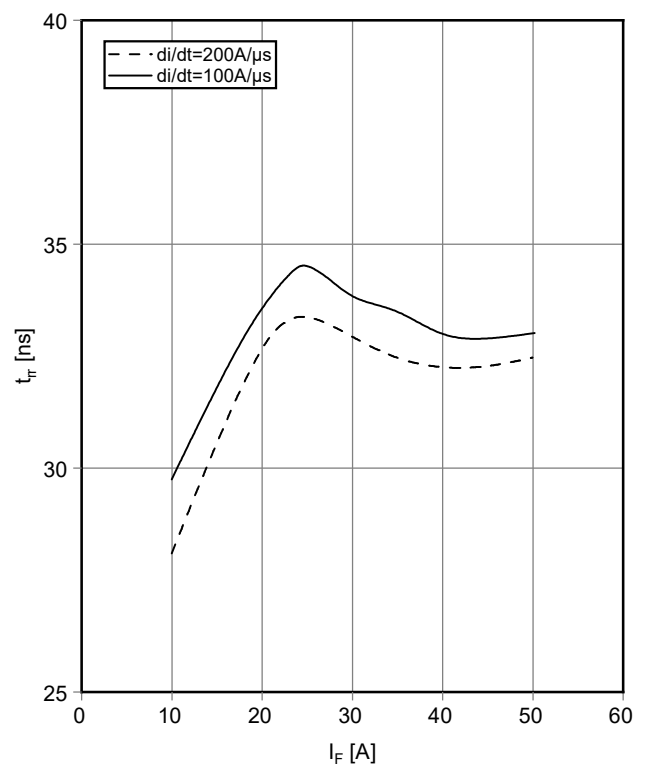
8. Typical switching energy losses as a function of collector current



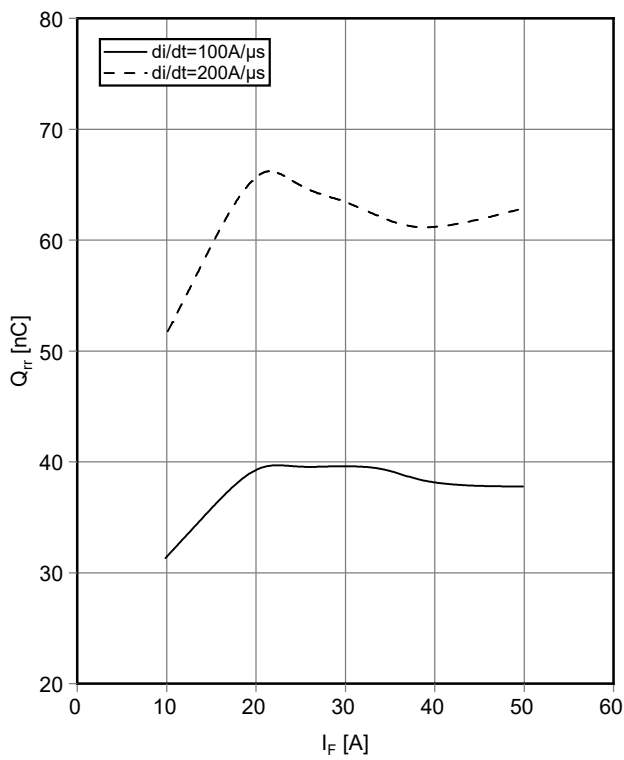
9. Typical FRD forward current as a function of forward voltage



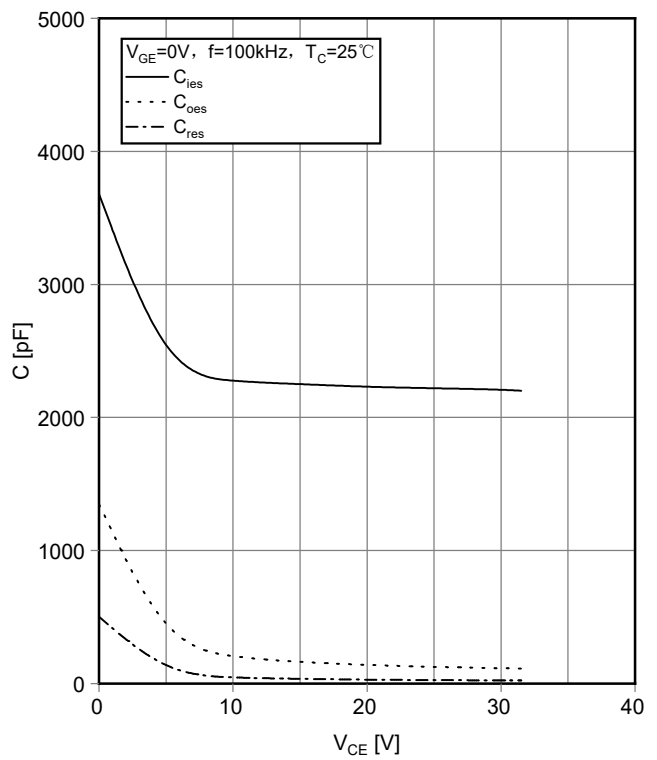
10. Typical reverse recovery time as a function of FRD forward current



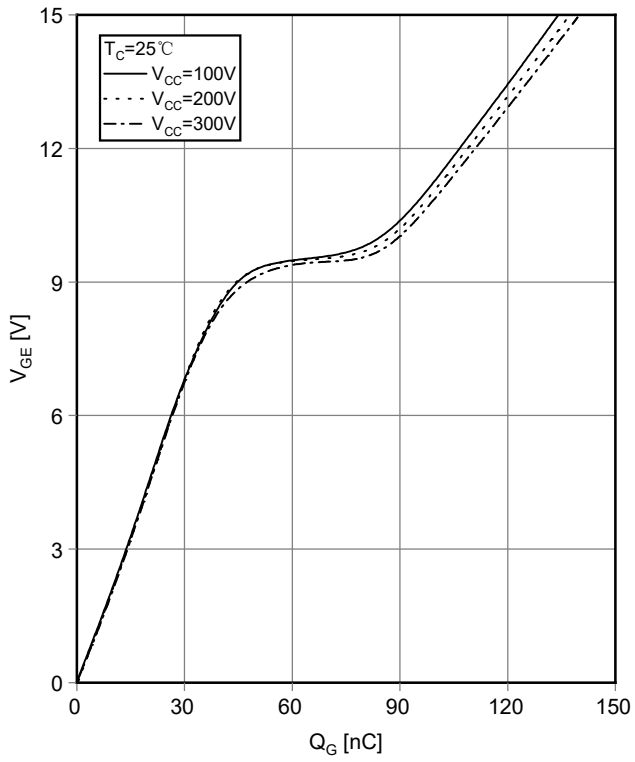
11. Typical reverse recovery charge as a function of FRD forward current



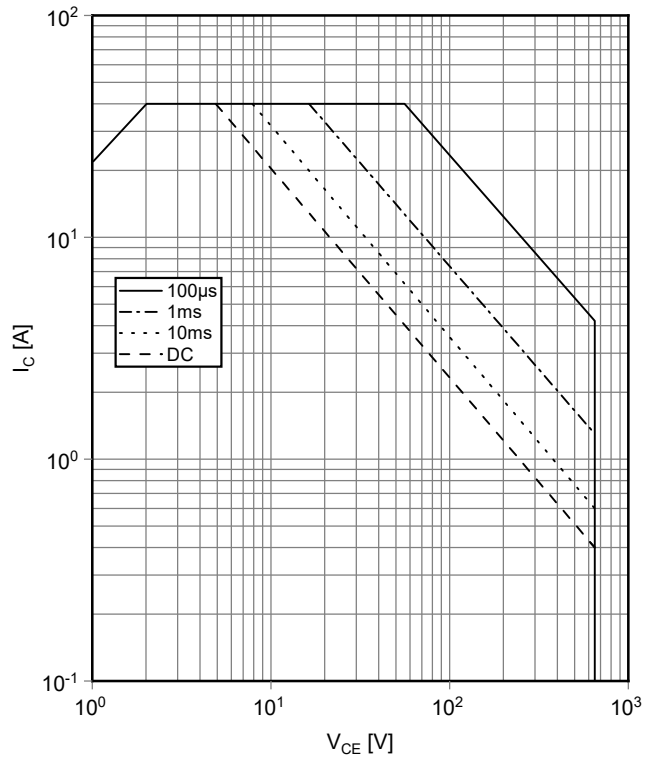
12. Typical capacitance as a function of collector-emitter voltage



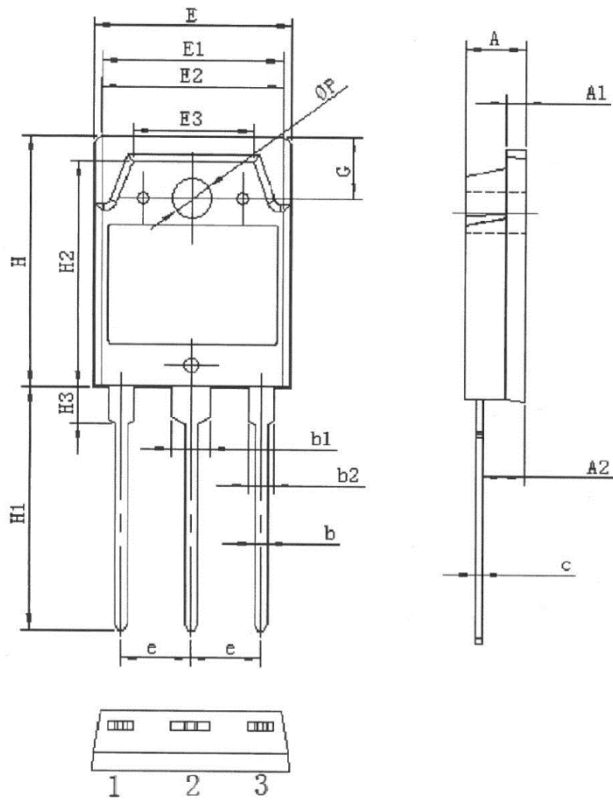
13. Typical gate charge



14. FBSOA



# PG-TO-3PN Outline Dimensions



Symbol	单位 mm		
	Min	Nom	Max
A	4.60	4.80	5.00
A1	1.3	1.5	1.7
A2	2.20	2.40	2.60
b	0.80	1.0	1.20
b1	2.90	3.10	3.30
b2	1.90	2.10	2.30
c	0.50	0.60	0.70
e	5.25	5.45	5.65
E	15.2	15.6	16.0
E1	13.2	13.4	13.6
E2	13.1	13.3	13.5
E3	9.1	9.3	9.5
H	19.8	20.0	20.2
H1	19.4	19.8	20.2
H2	18.5	18.7	18.9
H3	2.9	3.1	3.3
G	4.8	5.0	5.2
ΦP	3.00	3.20	3.40



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