![LSis logo]

LFC30G603

SISPM™

600V 30A PIM(CIB) IGBT Module

Features

Preliminary Data

- Trench Field Stop Technology IGBT adopted
- Low turn-off losses
- Positive Temperature Coefficient
- Short tail current
- Free Wheeling Diodes with fast and soft switching
- Industrial Standard Package with insulated substrate
- Temperature Sensor included

Applications

- Input from single or three phase grid
- Three Phase synchronous or asynchronous motor
- Dynamic Braking Operation

SISPM0
66.0 x 32.6 x 21.6mm

Internal Equivalent Circuit
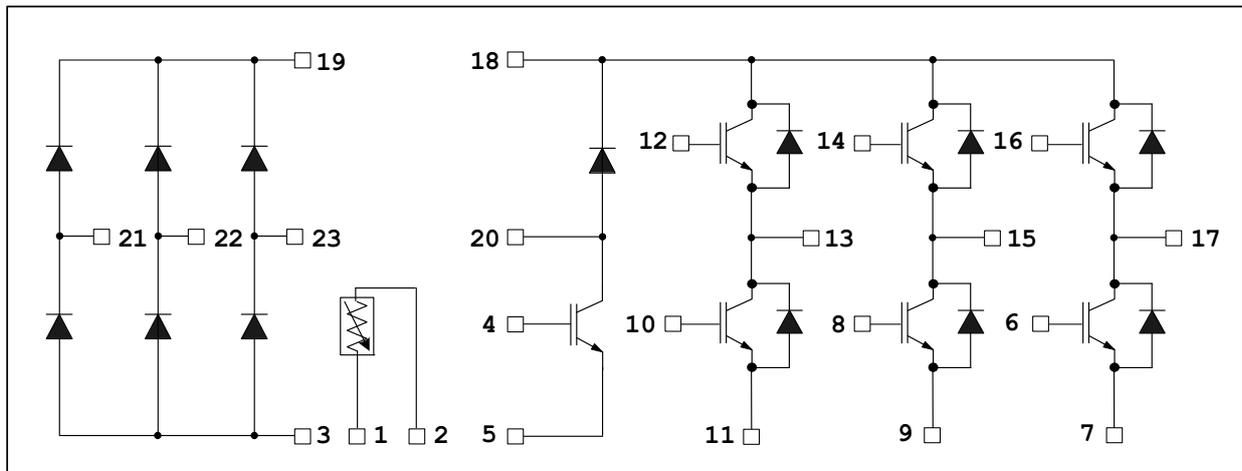
Pin Description

Pin Number	Pin Name	Pin Description
1, 2	TH1, TH2	NTC-, NTC+
3	N	Negative DC Link Input
4	GB	Gate Input for Braking IGBT
5	EB	Emitter Input for Braking IGBT
6, 8, 10	GWN, GVN, GUN	Gate Input for Low-side W Phase, V Phase, U Phase
7, 9, 11	WN, VN, UN	Negative DC Link output W Phase, V Phase, U Phase
12, 14, 16	GUP, GVP, GWP	Gate Input for High-side U Phase, V Phase, W Phase
13, 15, 17	U, V, W	Output for U Phase, V Phase, W Phase
18	DCP	Positive DC Link Output
19	P	Positive DC Link Input
20	B	Output for Braking
21, 22, 23	R, S, T	Input for R Phase, S Phase, T Phase

Absolute Maximum Ratings T_j = 25 °C unless otherwise noted

Item	Symbol	Parameter	Conditions	Value	Units
Input Rectifier	V_{RRM}	Repetitive Peak Reverse Voltage		1600	V
	I_{FAV}	Forward Current per Diode	@ T_j = 150 °C, T_C = 80 °C	35	A
	I_{FSM}	Surge Forward Current	@ T_j = 150 °C, t_P = 10 ms, half sine wave	200	A
	I^2t	I^2t - Value	@ T_j = 150 °C, t_P = 10 ms, half sine wave	200	A^2s
	P_D	Maximum Power Dissipation	@ T_j = 150 °C, T_C = 80 °C	55	W
	T_j	Operating Junction Temperature [*(1)]	-	-40 ~ 125	°C
Transistor Inverter	BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0 V, I_{CES} = 250 µA	600	V
	V_{GES}	Gate-Emitter Peak Voltage	-	± 20	V
	I_C	DC Collector Current	@ T_j = 175 °C, T_C = 80 °C	35	A
	I_{cpulse}	Repetitive Peak Collector Current	@ t_P = 1 ms	70	A
	P_D	Maximum Power Dissipation	@ T_j = 175 °C, T_C = 80 °C	85	W
	T_{SC}	SC Withstand Time (Chip level)	@ T_j = 150 °C, V_{GE} = 15 V, V_{CE} = 360 V	6	µs
	T_j	Operating Junction Temperature [*(2)]	-	-40 ~ 125	°C
Diode Inverter	V_{RRM}	Repetitive Peak Reverse Voltage	-	600	V
	I_F	DC Forward Current	@ T_j = 175 °C, T_C = 80 °C	25	A
	I_{FRM}	Repetitive Peak Forward Current	@ t_P = 1 ms	50	A
	P_D	Maximum Power Dissipation	@ T_j = 175 °C, T_C = 80 °C	50	W
	T_j	Operating Junction Temperature [*(1)]	-	-40 ~ 125	°C
Transistor Brake	BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0 V, I_{CES} = 250 µA	600	V
	V_{GES}	Gate-Emitter Peak Voltage	-	± 20	V
	I_C	DC Collector Current	@ T_j = 175 °C, T_C = 80 °C	25	A
	I_{cpulse}	Repetitive Peak Collector Current	@ t_P = 1 ms	50	A
	P_D	Maximum Power Dissipation	@ T_j = 175 °C, T_C = 80 °C	60	W
	T_{SC}	SC Withstand Time (Chip level)	@ T_j = 150 °C, V_{GE} = 15 V, V_{CE} = 360 V	6	µs
	T_j	Operating Junction Temperature [*(2)]	-	-40 ~ 125	°C
Diode Brake	V_{RRM}	Repetitive Peak Reverse Voltage	-	600	V
	I_F	DC Forward Current	@ T_j = 175 °C, T_C = 80 °C	25	A
	I_{FRM}	Repetitive Peak Forward Current	@ t_P = 1 ms	50	A
	P_D	Maximum Power Dissipation	@ T_j = 175 °C, T_C = 80 °C	55	W
	T_j	Operating Junction Temperature [*(1)]	-	-40 ~ 125	°C
Module	T_{stg}	Storage Temperature	-	-40 ~ 125	°C
	V_{iso}	Isolation Voltage	@ AC 1minute	2500	V
	W	Weight	-	30	g

(Note *1) The Maximum junction temperature of chip is 150 °C.
(Note *2) The Maximum junction temperature of chip is 175 °C.

LFC30G603

Electrical Characteristics T_j = 25 °C unless otherwise noted

Input Rectifier Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_F	Diode Forward Voltage	T_j = 25 °C, I_F = 30 A	-	1.3	-	V
		T_j = 125 °C, I_F = 30 A	-	1.3	-	V
V_{to}	Threshold Voltage (Chip level)	T_j = 125 °C	-	0.8	-	V
I_R	Reverse Current (Chip level)	T_j = 25 °C, V_{RRM}	-	0.05	-	mA
r_t	Slope Resistance (Chip level)	T_j = 125 °C	-	21	-	mΩ
$R_{th(J-C)}$	Thermal Resistance (DIODE Part)	Junction-to-Case	-	1.2	-	°C/W

Transistor-Inverter Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{GE(th)}$	Gate-Emitter threshold Voltage	V_{CE} = V_{GE}, I_{CE} = 30 mA	-	6.0	-	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	T_j = 25 °C, I_{CE} = 30 A, V_{GE} = 15 V	-	1.6	-	V
		T_j = 125 °C, I_{CE} = 30 A, V_{GE} = 15 V	-	2.0	-	V
I_{CES}	Collector-Emitter Cut-off Current	V_{GE} = 0 V, V_{CE} = 600 V	-	-	250	μA
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = 20 V, V_{CE} = 0 V (Chip level)	-	-	300	nA
C_{iss}	Input Capacitance	V_{CE} = 25 V, V_{GE} = 0 V f = 1 MHz, T_j = 25 °C	-	1700	-	pF
C_{oss}	Output Capacitance		-	98	-	pF
C_{rss}	Reverse Transfer Capacitance		-	52	-	pF
t_d(on)	Turn-On Delay Time	T_j = 125 °C, $R_{G\,ON}$ = 8.2 Ω $R_{G\,OFF}$ = 3.9 Ω, L = 1 mH V_{CE} = 300 V, V_{GE} = 15 V~0 V I_{CE} = 30 A	-	32	-	ns
t_r	Rise Time		-	27	-	ns
t_d(off)	Turn-Off Delay Time		-	220	-	ns
t_f	Fall Time		-	150	-	ns
E_{on}	Turn-On Switching Loss		-	0.7	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.9	-	mJ
E_{ts}	Total Switching Loss		-	1.6	-	mJ
Q_G	Total Gate Charge	V_{GE} = 0 V ~ 15 V	-	170	-	nC
Q_{GE}	Gate-Emitter Charge		-	24	-	nC
Q_{GC}	Gate-Collector Charge		-	83	-	nC
$R_{th(J-C)}$	Thermal Resistance (IGBT Part)	Junction-to-Case		1.1	-	°C/W

Diode-Inverter Characteristics T_j = 25 °C unless otherwise noted

Symbol	Parameter	Conditions		Min	Typ	Max	Units
V_F	Diode Forward Voltage	I_F = 30 A, V_{GE} = 0 V	T_j = 125 °C	-	2.0	-	V
t_{rr}	Diode Reverse Recovery Time	$R_{G\,ON}$ = 8.2 Ω L = 1 mH V_{CE} = 300 V V_{GE} = 15 V~0 V I_{CE} = 30 A	T_j = 125 °C	-	160	-	ns
I_{RRM}	Diode Peak Reverse Recovery Current		T_j = 125 °C	-	45	-	A
Q_{rr}	Diode Reverse Recovery Charge		T_j = 125 °C	-	2.0	-	μC
E_{rr}	Diode Reverse Recovery Energy		T_j = 125 °C	-	460	-	μJ
$R_{th(J-C)}$	Thermal Resistance (DIODE Part)	Junction-to-Case		-	1.9	-	°C/W

Transistor- Brake Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$V_{GE(th)}$	Gate-Emitter threshold Voltage	V_{CE} = V_{GE}, I_{CE} = 20 mA	-	6.3	-	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	T_j = 25 °C, I_{CE} = 20 A, V_{GE} = 15 V	-	1.6	-	V
		T_j = 125 °C, I_{CE} = 20 A, V_{GE} = 15 V	-	2.0	-	V
I_{CES}	Collector-Emitter Cut-off Current	V_{GE} = 0 V, V_{CE} = 600 V	-	-	250	μA
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = 20 V, V_{CE} = 0 V (Chip level)	-	-	300	nA
C_{iss}	Input Capacitance	V_{CE} = 25 V, V_{GE} = 0 V f = 1 MHz, T_j = 25 °C	-	1200	-	pF
C_{oss}	Output Capacitance		-	50	-	pF
C_{rss}	Reverse Transfer Capacitance		-	37	-	pF

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_d(on)$	Turn-On Delay Time	T_j = 125 °C, $R_{G\ ON}$ = 16 Ω $R_{G\ OFF}$ = 8 Ω, L = 1 mH V_{CE} = 300 V, V_{GE} = 15 V~0 V I_{CE} = 20 A	-	30	-	ns
t_r	Rise Time		-	28	-	ns
$t_d(off)$	Turn-Off Delay Time		-	220	-	ns
t_f	Fall Time		-	160	-	ns
E_{on}	Turn-On Switching Loss		-	0.5	-	mJ
E_{off}	Turn-Off Switching Loss		-	0.6	-	mJ
E_{ts}	Total Switching Loss		-	1.1	-	mJ
Q_G	Total Gate Charge	V_{GE} = 0 V ~ 15 V	-	122	-	nC
Q_{GE}	Gate-Emitter Charge		-	22	-	nC
Q_{GC}	Gate-Collector Charge		-	59	-	nC
$R_{th(J-C)}$	Thermal Resistance (IGBT Part)	Junction-to-Case	-	1.5	-	°C/W

Diode-Brake Characteristics T_C = 25 °C unless otherwise noted0

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
V_F	Diode Forward Voltage	I_F = 20 A, V_{GE} = 0 V	T_j = 125 °C	-	1.6	-	V
t_{rr}	Diode Reverse Recovery Time	$R_{G\ ON}$ = 16 Ω L = 1 mH V_{CE} = 300 V V_{GE} = 15 V~0 V I_{CE} = 20 A	T_j = 125 °C	-	330	-	ns
I_{RRM}	Diode Peak Reverse Recovery Current		T_j = 125 °C	-	13	-	A
Q_{rr}	Diode Reverse Recovery Charge		T_j = 125 °C	-	1.5	-	µC
E_{rr}	Diode Reverse Recovery Energy		T_j = 125 °C	-	330	-	µJ
$R_{th(J-C)}$	Thermal Resistance (DIODE Part)	Junction-to-Case		-	1.7	-	°C/W

NTC thermistar Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
R_{25}	Resistance	T_C = 25 °C	-	22	-	kΩ
P	Power	T_C = 25 °C	-	210	-	mW
$B_{25/100}$	B Constant	T_C = 25 °C, ± 3% tolerance	-	4000	-	K

* This specifications may not be considered as an assurance of characteristics and may not have same characteristics.
  in case of using different test systems from @LSIS. We therefore strongly recommend prior consultation of our engineers.

LFC30G603

Input Rectifier
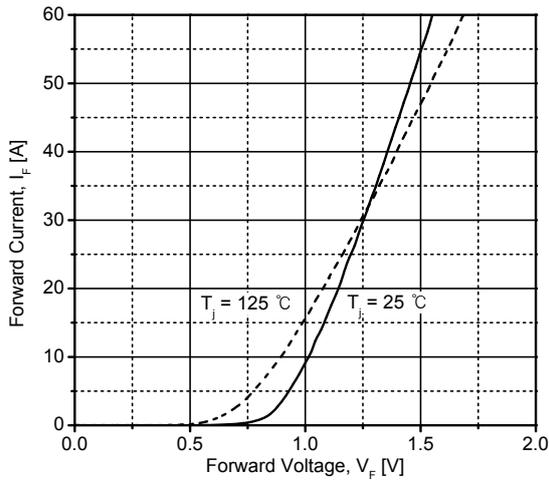
Fig 1. Typical Diode Forward Characteristics

Fig 2. Case Temperature vs. Forward Current

i	1	2	3	4
ri[K/W]:	0.010	0.240	0.650	0.289
tau[s]:	0.00003	0.00112	0.01334	0.05970
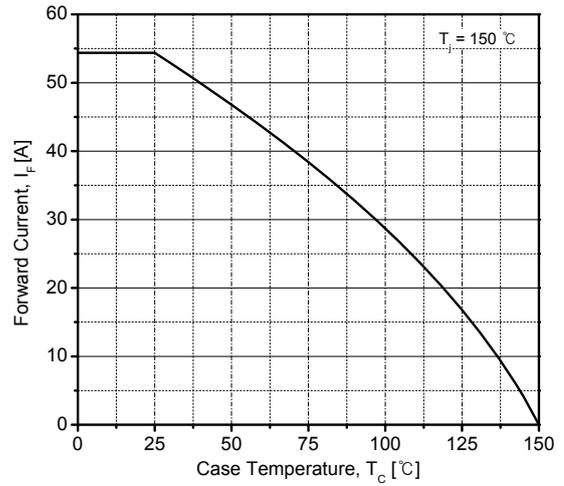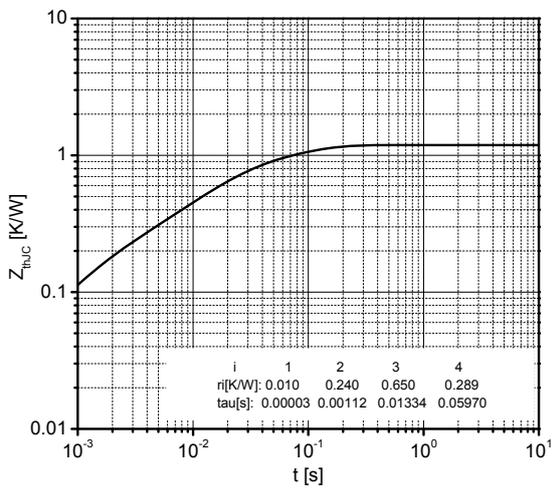
Fig 3. Typical Diode Thermal Impedance

Transistor-Inverter/Diode-Inverter
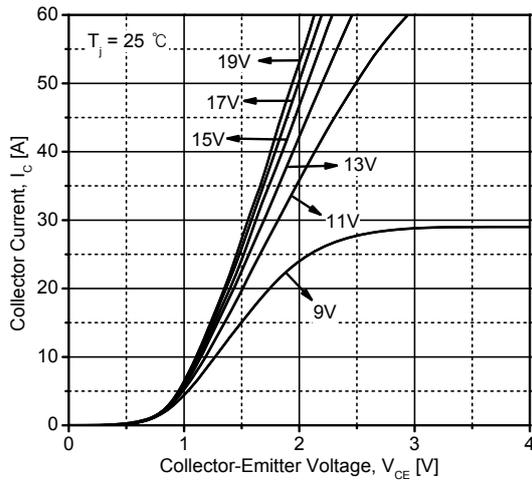
Fig 4. Typical IGBT Output Characteristics
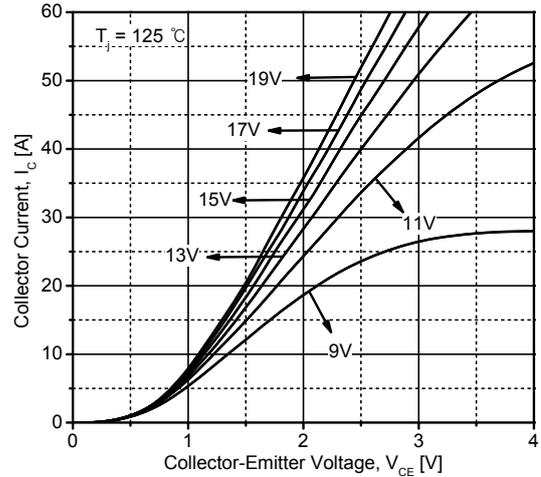
Fig 5. Typical IGBT Output Characteristics
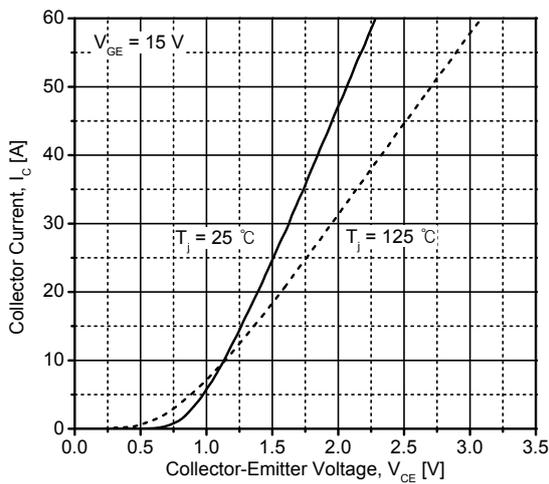
**Fig 6. Typical IGBT Output Characteristics**
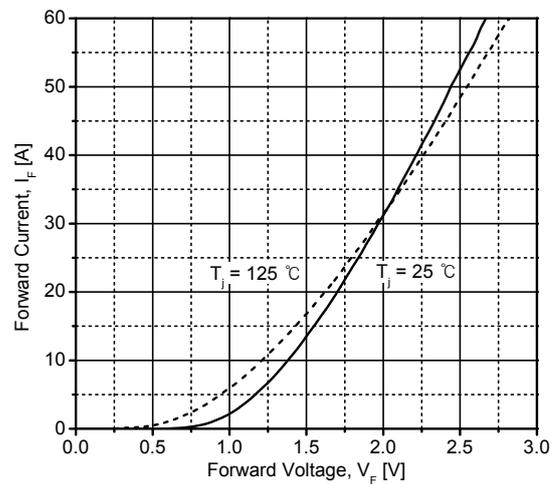
Fig 7. Typical Diode Forward Characteristics
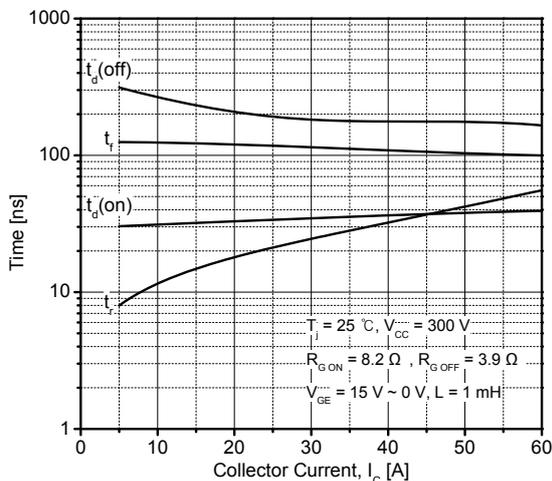
Fig 8. Typical Switching Time vs. Collector Current
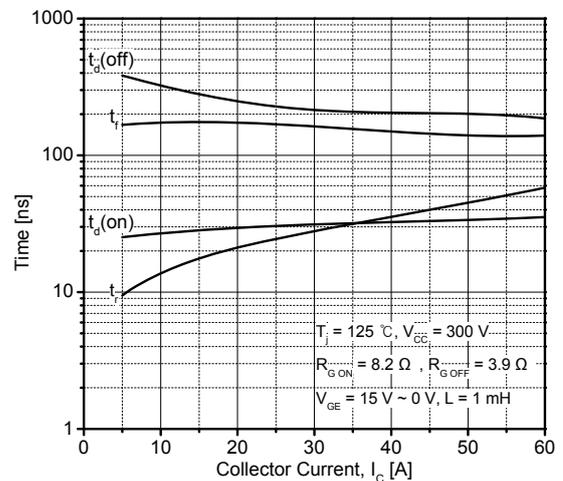
Fig 9. Typical Switching Time vs. Collector Current

LFC30G603

## Transistor-Inverter/Diode-Inverter
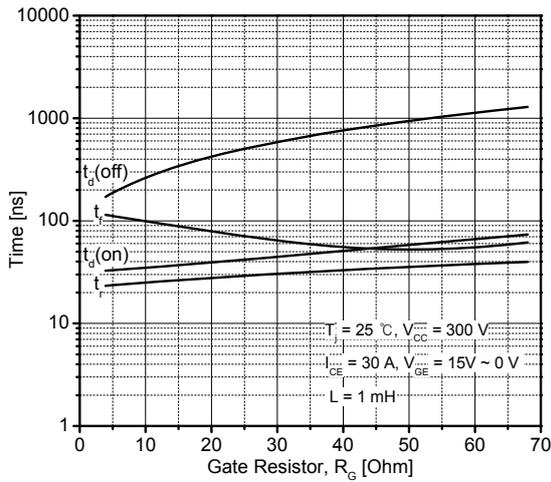
Fig 10. Typical Switching Time vs. Gate Resistor
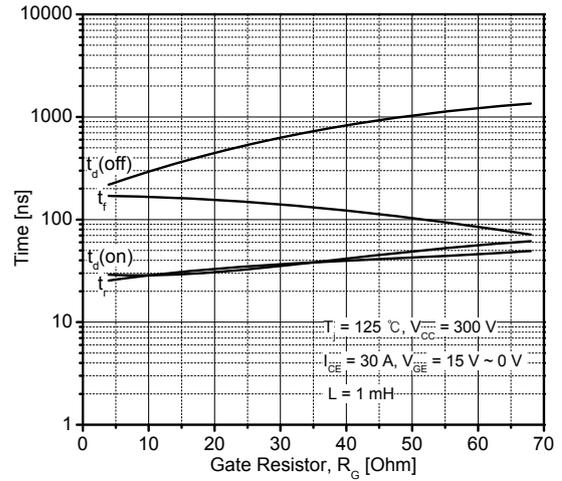

Fig 11. Typical Switching Time vs. Gate Resistor
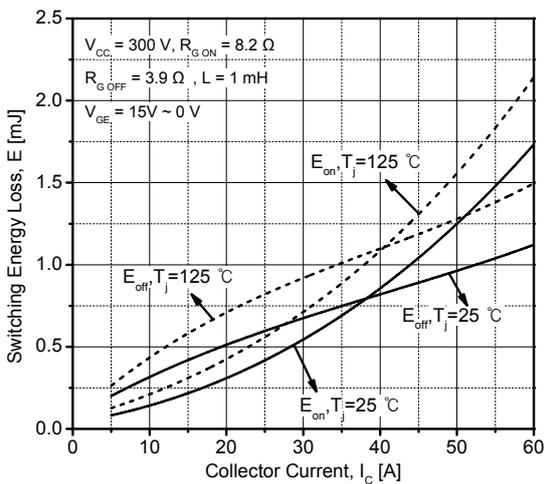

Fig 12. Typical IGBT Switching Loss
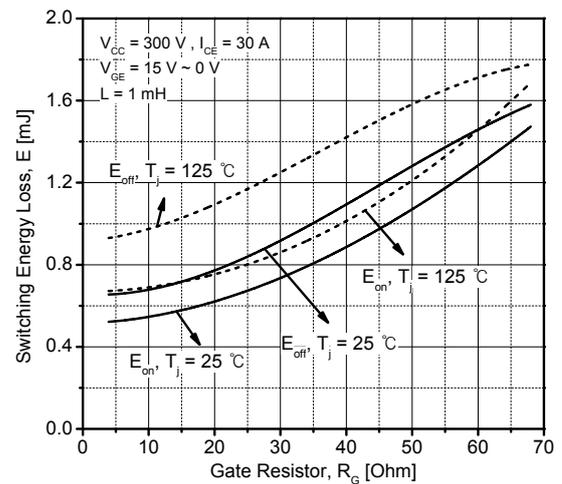
Fig 13. Typical IGBT Switching Loss
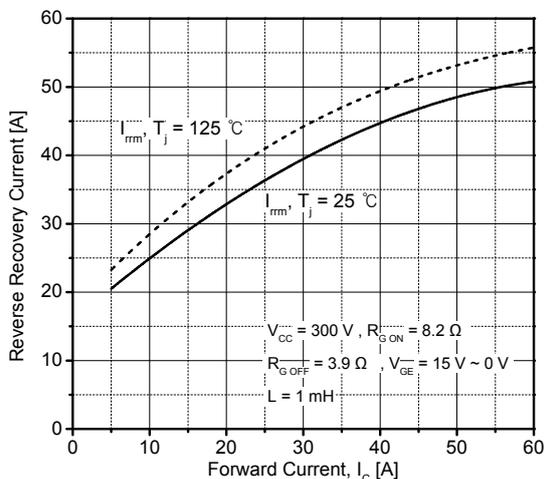
Fig 14. Typical Recovery Characteristics of Diode
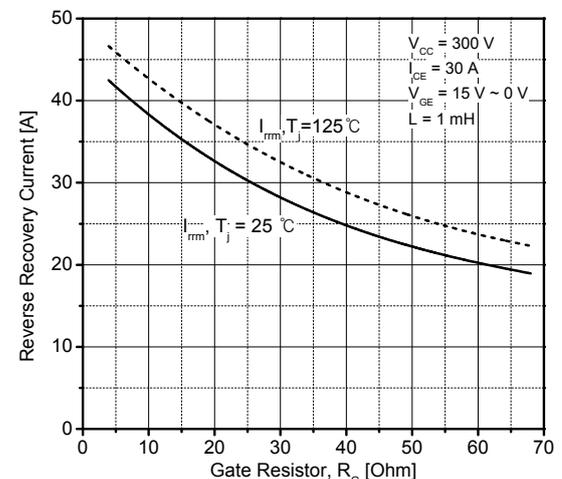
Fig 15. Typical Recovery Characteristics of Diode

Transistor-Inverter/Diode-Inverter
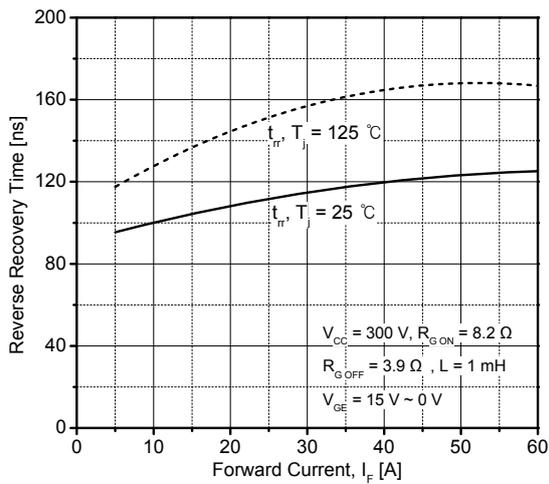
Fig 16. Typical Recovery Characteristics of Diode
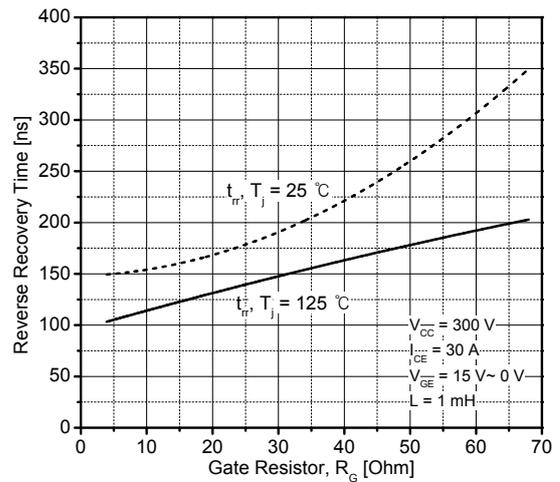
Fig 17. Typical Recovery Characteristics of Diode
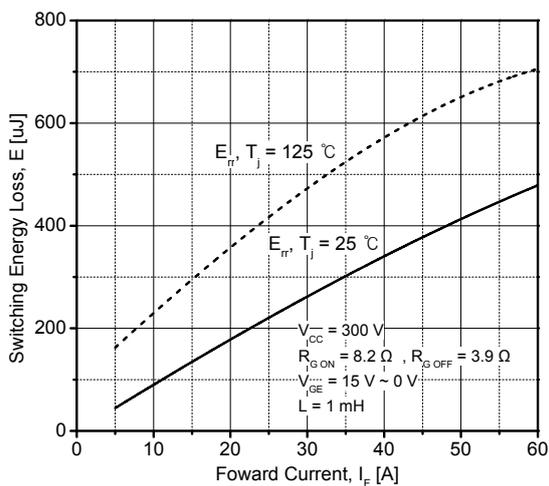
Fig 18. Typical Diode Switching Loss
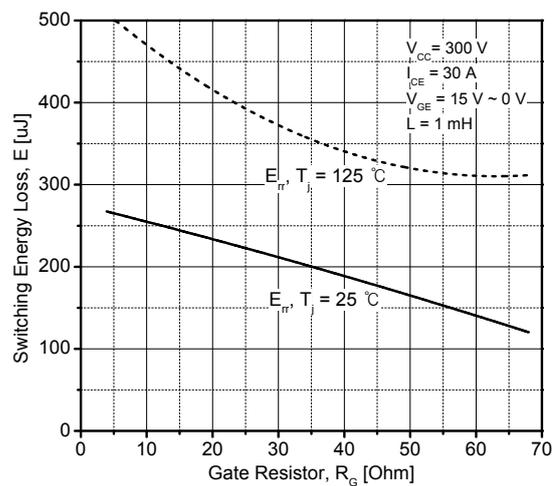
Fig 19. Typical Diode Switching Loss
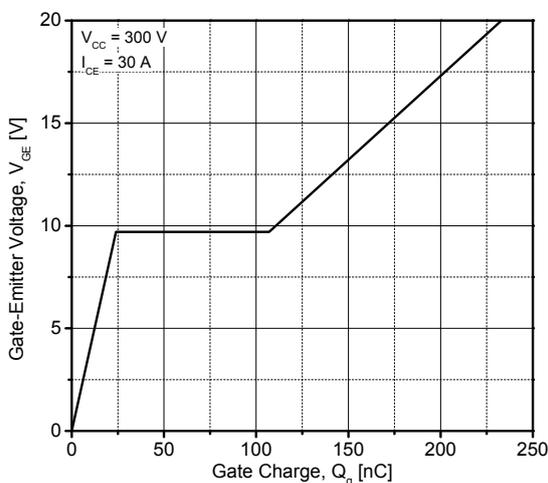
Fig 20. Typical Gate Charge Characteristics
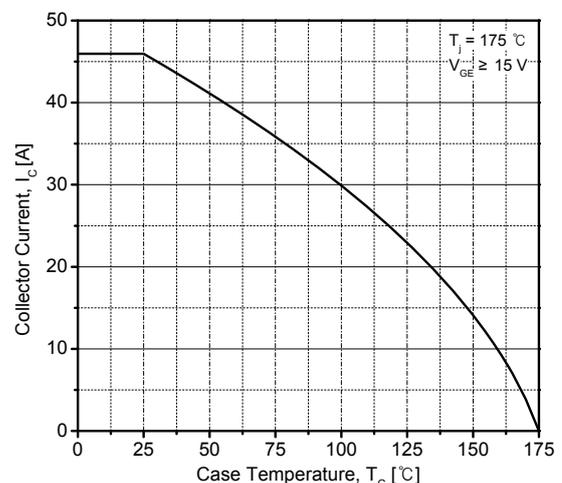
Fig 21. Case Temperature vs. Collector Current

LFC30G603

Transistor-Inverter/Diode-Inverter
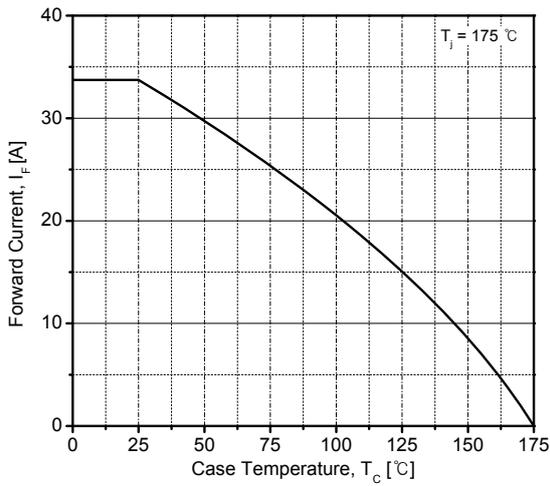
Fig 22. Case Temperature vs. Forward Current

Fig 23. Typical Igbt Thermal Impedance

i	1	2	3	4
ri[K/W]:	0.027	0.147	0.637	0.275
tau[s]:	0.00005	0.0002	0.01403	0.0401

Fig 24. Typical Diode Thermal Impedance

i	1	2	3	4
ri[K/W]:	0.047	0.333	0.932	0.602
tau[s]:	0.00003	0.00022	0.00907	0.03909

Transistor-Brake/Diode-Brake

Fig 25. Typical IGBT Output Characteristics
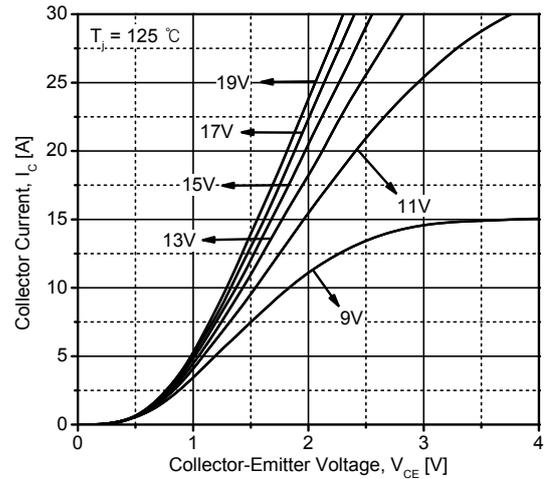
Fig 26. Typical IGBT Output Characteristics
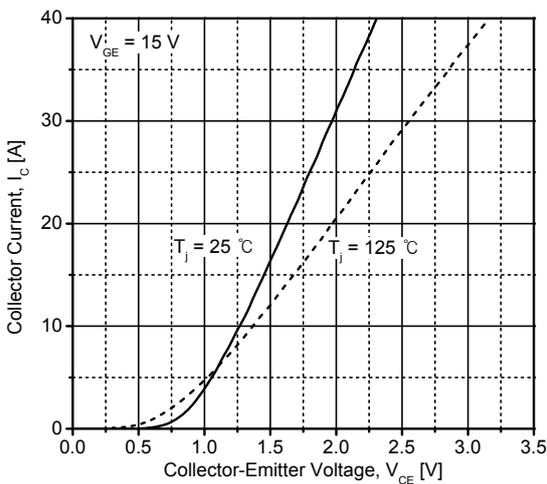
Fig 27. Typical IGBT Output Characteristics
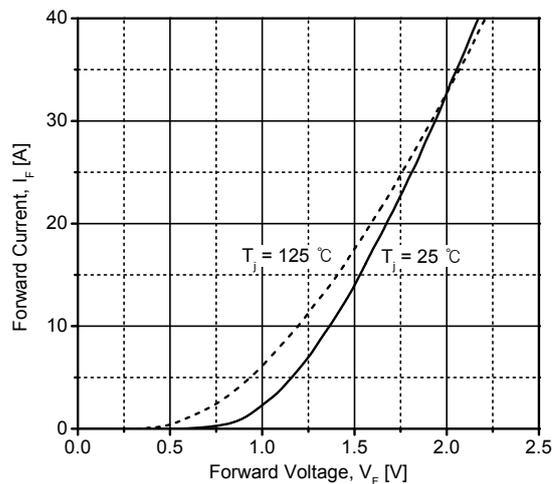
Fig 28. Typical Diode Forward Characteristics
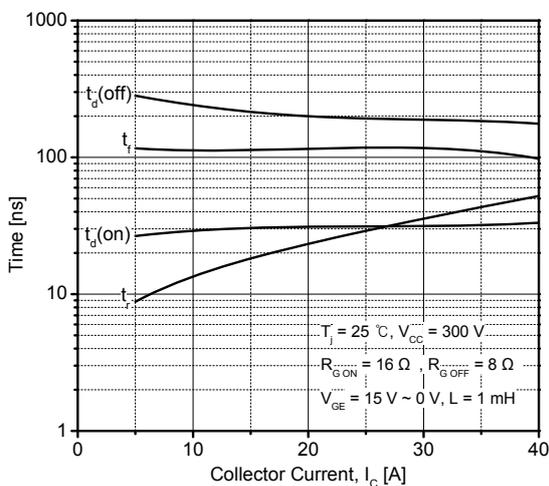
Fig 29. Typical Switching Time vs. Collector Current
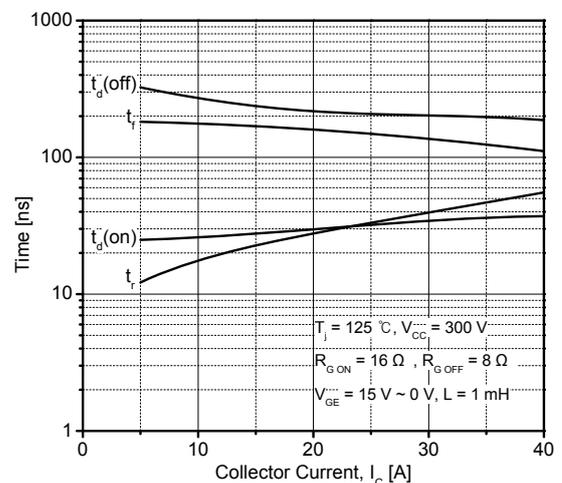
Fig 30. Typical Switching Time vs. Collector Current

LFC30G603

Transistor-Brake/Diode-Brake
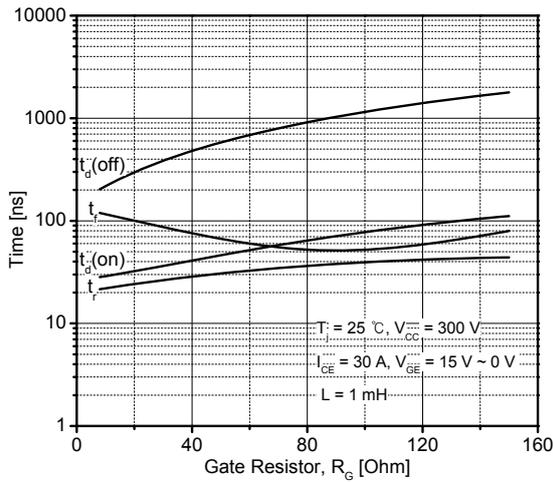
Fig 31. Typical Switching Time vs. Gate Resistor
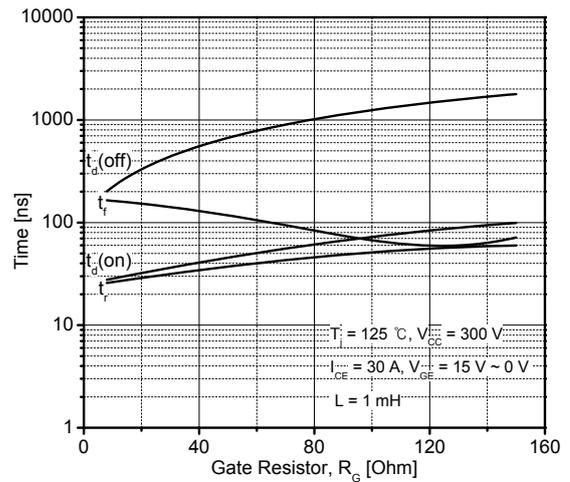
Fig 32. Typical Switching Time vs. Gate Resistor
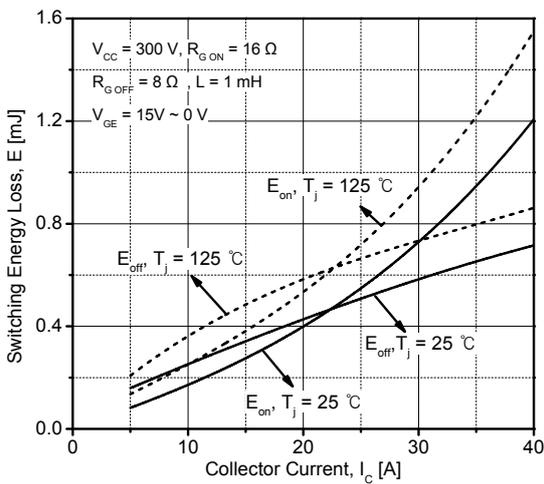
Fig 33. Typical IGBT Switching Loss
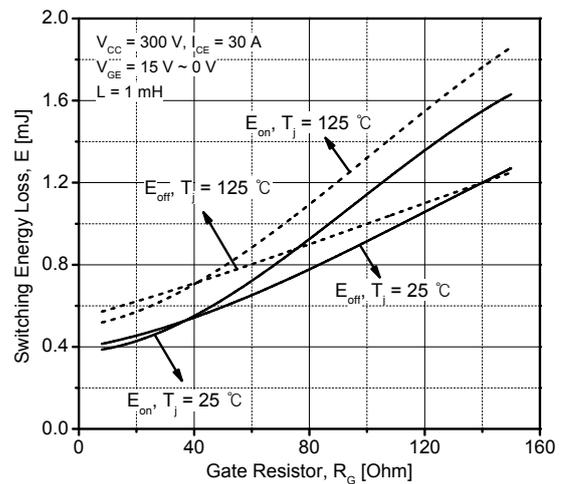
Fig 34. Typical IGBT Switching Loss
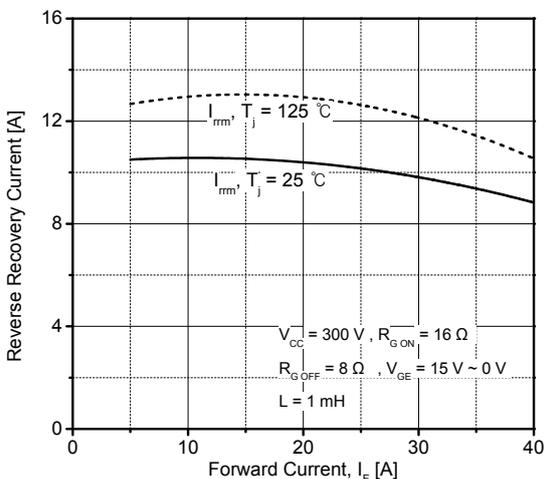
Fig 35. Typical Recovery Characteristics of Diode
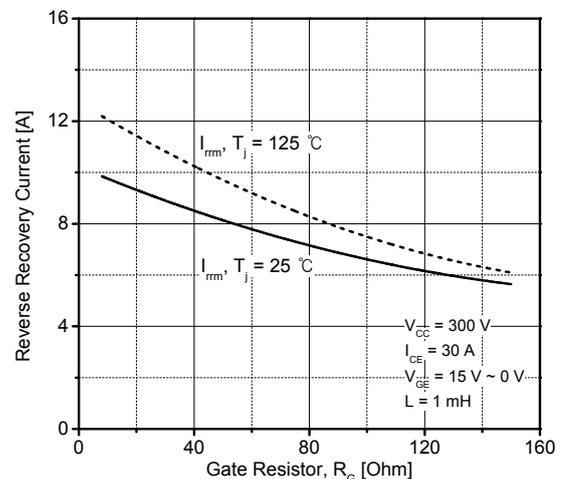
**Fig 36. Typical Recovery Characteristics of Diode**

Transistor-Brake/Diode-Brake
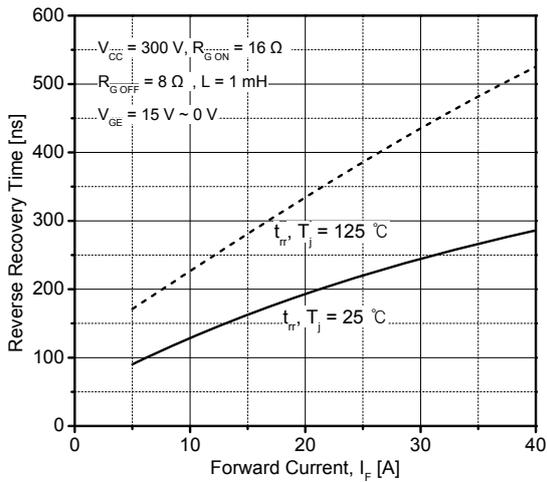
Fig 37. Typical Recovery Characteristics of Diode
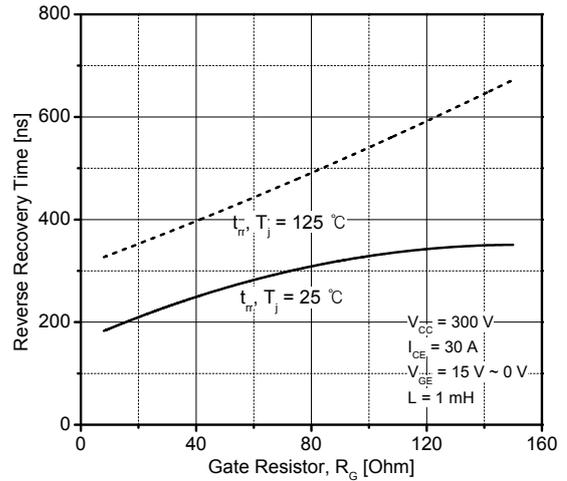
Fig 38. Typical Recovery Characteristics of Diode
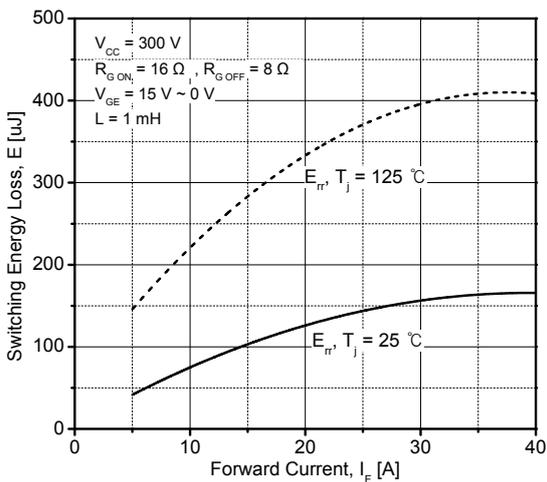
Fig 39. Typical Diode Switching Loss
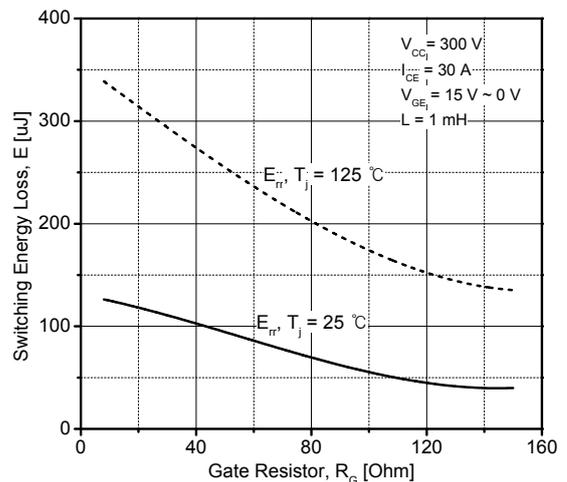
Fig 40. Typical Diode Switching Loss
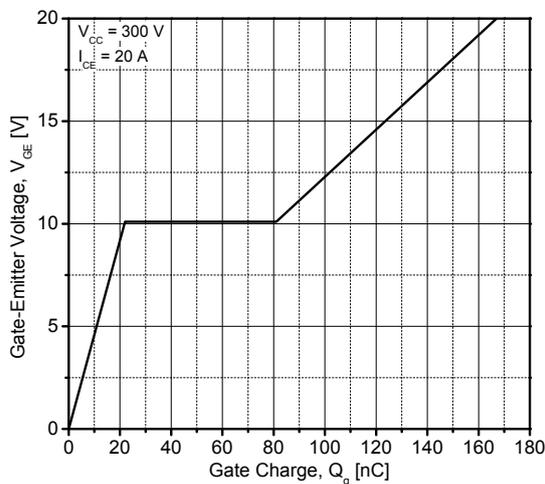
Fig 41. Typical Gate Charge Characteristics
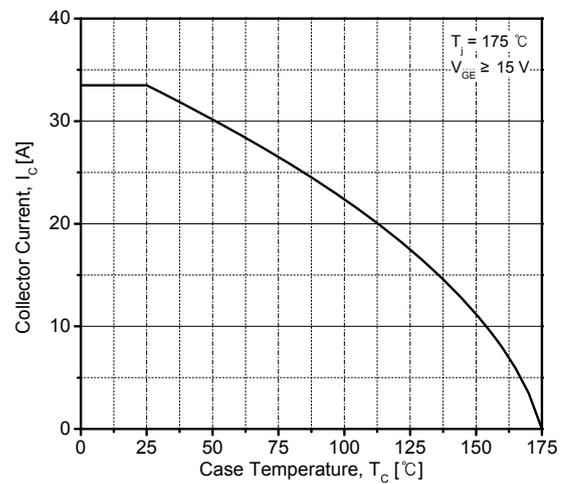
Fig 42. Case Temperature vs. Collector Current

LFC30G603

Transistor-Brake/Diode-Brake
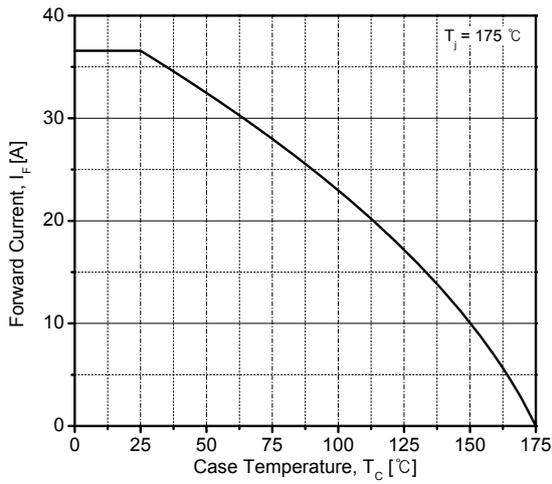
**Fig 43. Case Temperature vs. Forward Current**
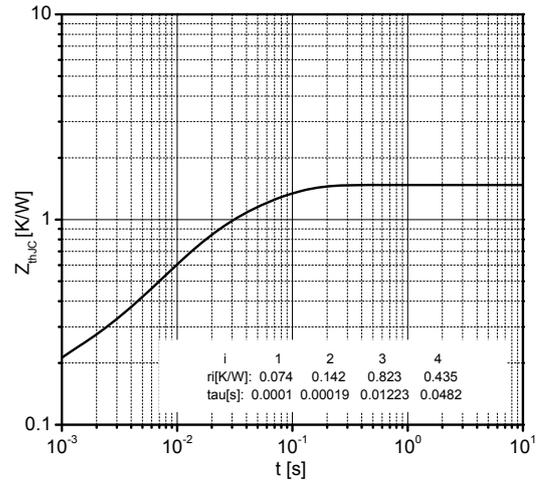

Fig 44. Typical Igbt Thermal Impedance

i	1	2	3	4
ri[K/W]:	0.074	0.142	0.823	0.435
tau[s]:	0.0001	0.00019	0.01223	0.0482

Fig 45. Typical Diode Thermal Impedance

| i	1	2	3	4
ri[K/W]:	0.037	0.301	0.843	0.537
tau[s]:	0.00002	0.0002	0.00847	0.03769
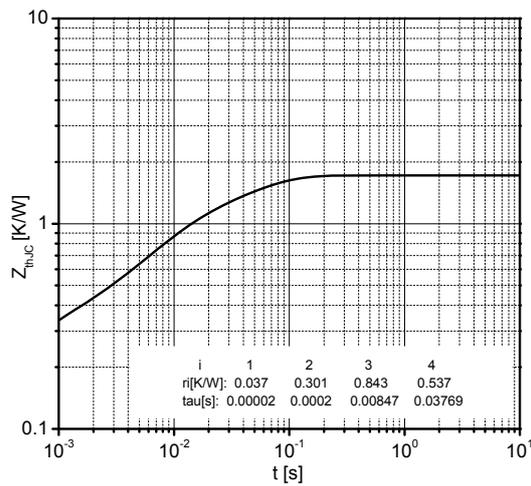
NTC
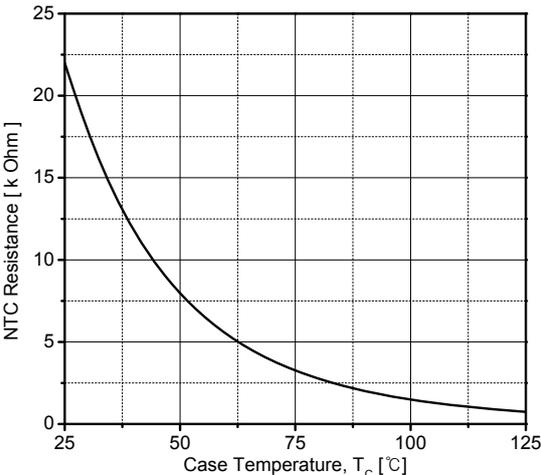
Fig 46. Typical NTC Characteristics

LFC30G603

Package Dimension(Dimension in mm)