LS Industrial Systems

June 2008

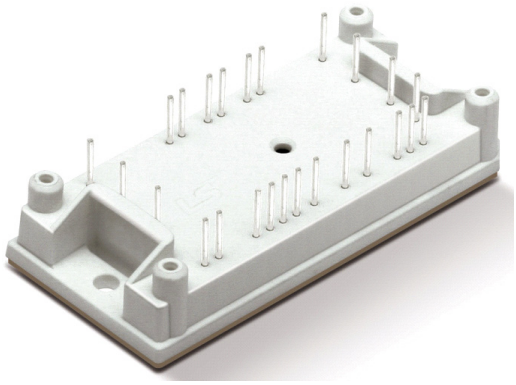
SISPM1

LEC15G604_Preliminary

600V/15A PIM

General Description

LSIS's New PIM (Power Intergrated Module) provides low conduction and switching losses as well as short circuit ruggedness.
It is designed for applications such as general inverters and sewing machines.



Package Code : SISPM1

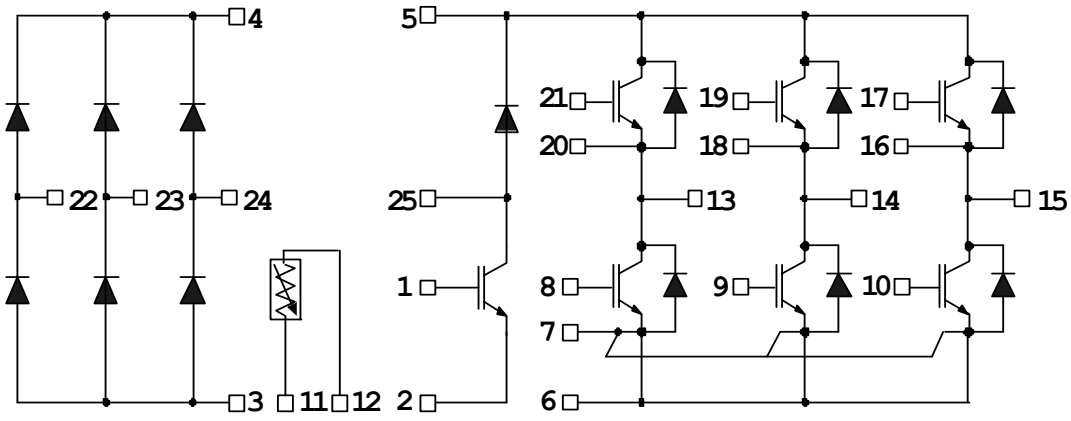
Features

- Trench Field Stop Technology adopted IGBT
  - Low saturation voltage
  - Positive temperature coeffiecient
  - Fast switching
- Free wheeling diodes with fast and soft reverse recovery
- 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

Internal Equivalent Circuit



Absolute Maximum Rating T_C = 25°C unless otherwise noted

Item	Symbol	Description	Condition	Rating	Unit
Input Rectifier	V_{RRM}	Repetitive peak reverse voltage	T_c=25℃, I_R=250uA	1600	V
	I_{FAV}	Forward current per diode	T_c=80℃	18	A
	I_{FSM}	Surge forward current	t_p=10ms, half sine wave	220	A
	I^2t	I^2t-value	t_p=10ms, half sine wave	200	A^2s
	P_D	Maximum power dissipation	-	-	W
	T_J	Operating junction temperature	-	-40 ~ +125	℃
	T_{stg}	Storage temperature range	-	-40 ~ +150	℃
	$R_{th(j-c)}$	j-c Thermal Resistance	-	1.91	K/W
Transistor Inverter	V_{CE}	Collector-emitter break down voltage	T_c=25℃, I_c=250uA	600	V
	I_C	DC collector current	Tc=25℃ Tc=100℃	24 12	A
	I_{cpuls}	Repetitive peak collector current	tp=1ms, T_c=80℃	48	A
	P_D	Maximum power dissipation	Tc=25℃	-	W
	V_{GE}	Gate-emitter peak voltage	Continuous	±20	V
	t_{sc}	SC withstand time	Tc ≤ 125℃, V_{CE}=300V	5	us
	T_J	Operating junction temperature	-	-40 ~ +125	℃
	T_{stg}	Storage temperature range	-	-40 ~ +150	℃
	$R_{th(j-c)}$	j-c Thermal Resistance	-	2.31	K/W
Diode Inverter	V_{RRM}	Repetitive peak reverse voltage	T_c=25℃, I_R=250uA	600	V
	I_{FAV}	DC forward current	T_c=80℃	16	A
	I_{FSM}	Surge forward current	t_p=10ms, half sine wave	110	A
	P_D	Maximum power dissipation	-	-	W
	T_J	Operating junction temperature	-	-40 ~ +125	℃
	T_{stg}	Storage temperature range	-	-40 ~ +150	℃
	$R_{th(j-c)}$	j-c Thermal Resistance	-	2.53	K/W
Transistor BRC	V_{CE}	Collector-emitter break down voltage	T_c=25℃, I_c=250uA	600	V
	I_C	DC collector current	Tc=25℃ Tc=100℃	24 12	A
	I_{cpuls}	Repetitive peak collector current	t_p=1ms, T_c=80℃	48	A
	P_D	Maximum Power dissipation	Tc=25℃	-	W
	V_{GE}	Gate-emitter peak voltage	Continuous	±20	V
	t_{sc}	SC withstand time	Tc ≤ 125℃, V_{CE}=300V	5	us
	T_J	Operating junction temperature	-	-40 ~ +125	℃
	T_{stg}	Storage temperature range	-	-40 ~ +150	℃
	$R_{th(j-c)}$	j-c Thermal Resistance	-	2.86	K/W
Diode BRC	V_{RRM}	Repetitive peak reverse voltage	T_c=25℃, I_R=250uA	600	V
	I_{FAV}	DC forward current	T_c=80℃	16	A
	I_{FSM}	Surge forward current	t_p=10ms, half sine wave	110	A
	P_D	Maximum power dissipation	-	2.53	W
	T_J	Operating junction temperature	-	-40 ~ +125	℃
	T_{stg}	Storage temperature range	-	-40 ~ +150	℃
	$R_{th(j-c)}$	j-c Thermal Resistance	-	-	K/W
Insulation properties	V_{iso}	Isolation voltage	AC 1 min	2500	V
Mounting Torque	Md	Heatsink Mounting Screw	-	-	N.m

Electrical Characteristics T_C = 25°C unless otherwise noted

Input Rectifier

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
V_F	Diode forward voltage	T_c=25℃, I_F=15A T_c=125℃, I_F=15A	- -	1.35 1.35	- -	V
I_R	Diode reverse current	V_R=1600V	-	-	0.05	mA
t_{rr}	Diode reverse recovery current	T_c=25℃, ± 1A	-	20	-	us

Transistor Inverter, inductive load

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE}=V_{GE}, Ic=350uA	4.0	-	6.5	V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	Tc=25℃, Ic=15A, V_{GE}=15V Tc=125℃, Ic=15A, V_{GE}=15V	- -	1.85 2.20	- -	V
I_{CES}	Collector-emitter cut-off current	V_{GE}=0V, V_{CE}=600V	-	-	250	uA
I_{GES}	Gate-emitter leakage current	V_{GE}= ± 20V, V_{CE}=0V	-	-	± 100	nA
$t_{d(on)}$	Turn-on delay time	T_C=25℃ R_G(on)=40 Ohm R_G(off)=20 Ohm V_{GE}=15V ~ 0V I_C=15A	-	90	-	ns
t_r	Rise time		-	45	-	ns
$t_{d(off)}$	Turn-off delay time		-	152	-	ns
t_f	Fall time		-	55	-	ns
E_{on}	Turn-on energy loss per pulse		-	0.205	-	mJ
E_{off}	Turn-off energy loss per pulse		-	0.261	-	mJ
C_{ies}	Input capacitance	V_{GE}= ± 15V, V_{DC}=30V f=1MHz, Tc=25C	-	-	-	nF
C_{oss}	Output capacitance		-	-	-	nF
C_{rss}	Reverse transfer capacitance		-	-	-	nF
C_{ies}	Input capacitance	V_{GE}= ± 15V, V_{DC}=30V f=1MHz, Tc=125C	-	-	-	nF
C_{oss}	Output capacitance		-	-	-	nF
C_{rss}	Reverse transfer capacitance		-	-	-	nF
Q_{Gate}	Gate charge	Ic=15A, V_{GE}=15V, V_{DC}=300V	-	-	-	nC

Diode Inverter

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
V_F	Diode forward voltage	T_c=25℃, I_F=15A T_c=125℃, I_F=15A	- -	1.52 1.57	- -	V
I_R	Diode reverse current	T_c=25℃,V_R=600V	-	-	0.1	mA
t_{rr}	Diode reverse recovery current	± 9.5A, 300V, 150A/us	-	-	-	ns
Q_{rr}	Diode reverse recovery charge	± 9.5A, 300V, 150A/us	-	-	-	uC

Transistor BRC, inductive load

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE}=V_{GE}, Ic=350uA	4.0	-	6.5	V
$V_{CE(SAT)}$	Collector-emitter saturation voltage	Tc=25℃, Ic=15A, V_{GE}=15V Tc=125℃, Ic=15A, V_{GE}=15V	- -	1.86 2.20	- -	V
I_{CES}	Collector-emitter cut-off current	V_{GE}=0V, V_{CE}=600V	-	-	250	uA

I_{GES}	Gate-emitter leakage current	V_{GE}= ± 20V, V_{CE}=0V	-	-	± 100	nA
$t_{d(on)}$	Turn-on delay time	T_C=25℃ R_G(on)=47.5 Ohm R_G(off)=24.5 Ohm V_{GE}=15V~0V I_C=14A	-	90	-	ns
t_r	Rise time		-	45	-	ns
$t_{d(off)}$	Turn-off delay time		-	152	-	ns
t_f	Fall time		-	55	-	ns
E_{on}	Turn-on energy loss per pulse		-	0.325	-	mJ
E_{off}	Turn-off energy loss per pulse		-	0.286	-	mJ
C_{ies}	Input capacitance	V_{GE}=0V, V_{DC}=30V, f=1MHz	-	765	-	nF
C_{oss}	Output capacitance		-	52	-	nF
C_{rss}	Reverse transfer capacitance		-	23	-	nF
Q_{Gate}	Gate charge	Ic=15A, V_{GE}=15V, V_{DC}=300V	-	-	-	nC

Diode BRC

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
V_F	Diode forward voltage	T_c=25℃, I_F=15A T_c=125℃, I_F=15A	- -	1.52 1.57	- -	V
I_R	Diode reverse current	T_c=25℃,V_R=600V	-	-	0.1	mA
t_{rr}	Diode reverse recovery current	± 9.5A, 300V, 150A/us	-	-	-	ns
Q_{rr}	Diode reverse recovery charge	± 9.5A, 300V, 150A/us	-	-	-	uC

NTC-Thermistor

Symbol	Description	Conditions	Min.	Typ.	Max.	Unit
R_{25}	Rated resistance	Tc=25℃	-	4.7	-	KOhm
$D_{R/R}$	Deviation of R100	Tc=100℃	-	2.9	-	%/K
P	Power dissipation given Epcos-Typ	Tc=25℃	-	210	-	mW
$B_{(25/100)}$	B-value	Tc=25℃	-	3980	-	K

1. Output Inverter IGBT/DIODE

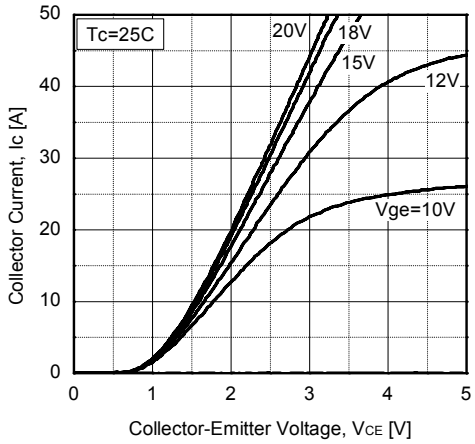


Fig.1 Typical Ouput Characteristics

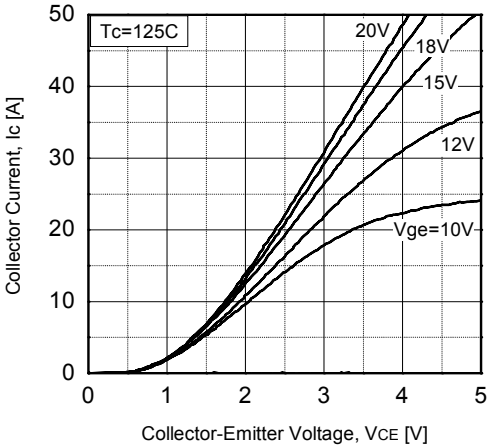


Fig.2 Typical Ouput Characteristics

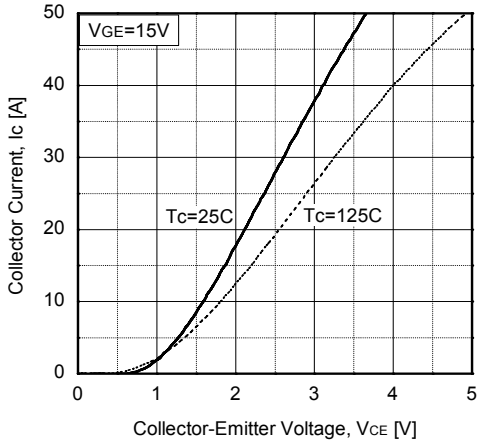


Fig3. Typical Transfer Characteristics

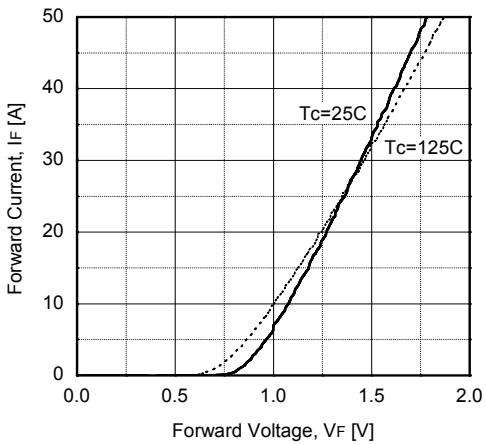


Fig4. Typical Forward Current

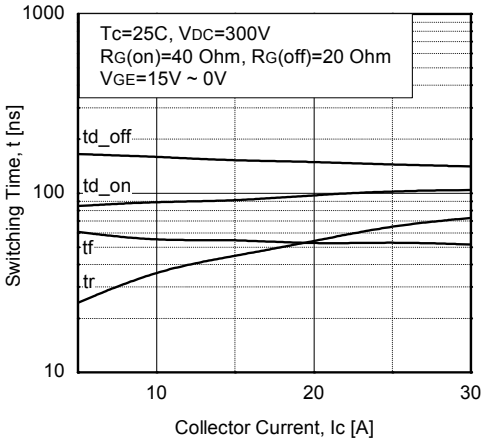


Fig5. Typical Switching Time vs I_C

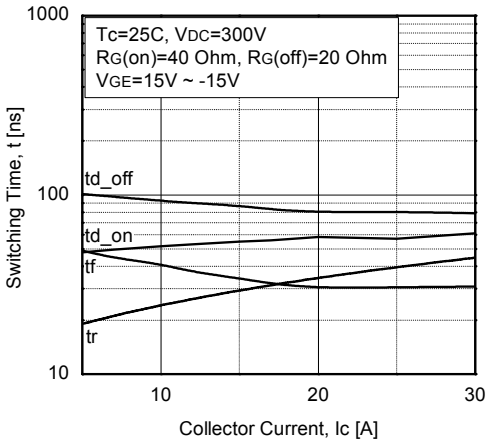


Fig6. Typical Switching Time vs I_C

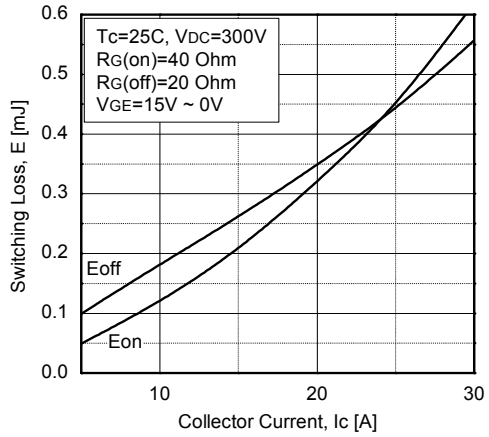


Fig7. Typical Switching Loss vs I_C

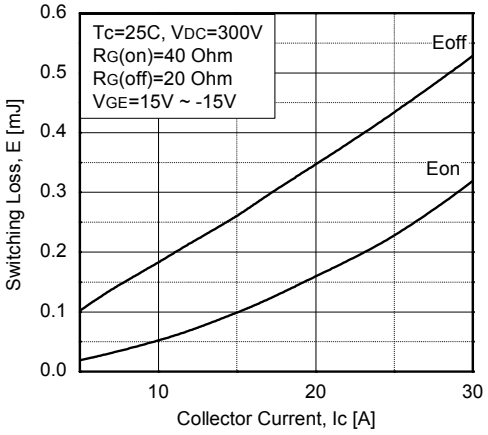


Fig8. Typical Switching Loss vs I_C

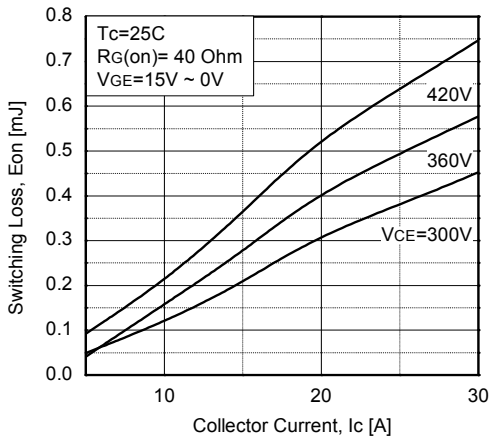


Fig9. Typical Switching Loss(E_{on}) vs I_C

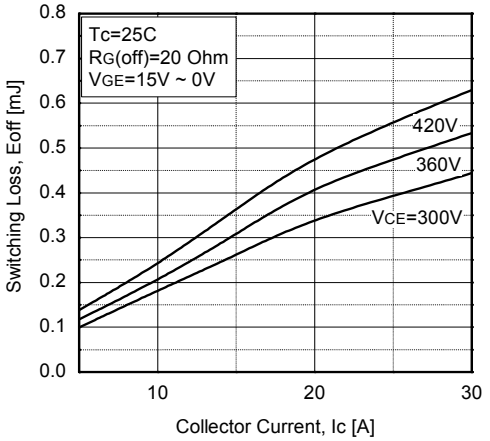


Fig10. Typical Switching Loss(E_{off}) vs I_C

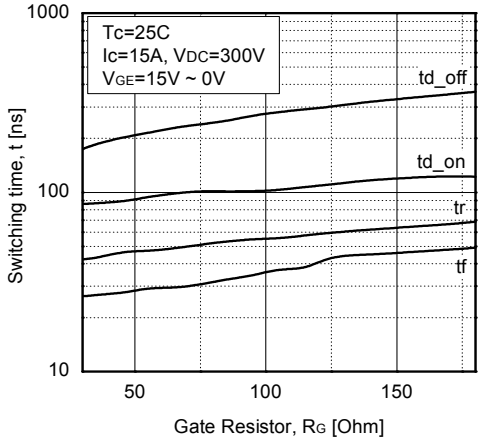


Fig11. Typical Switching Time vs RG

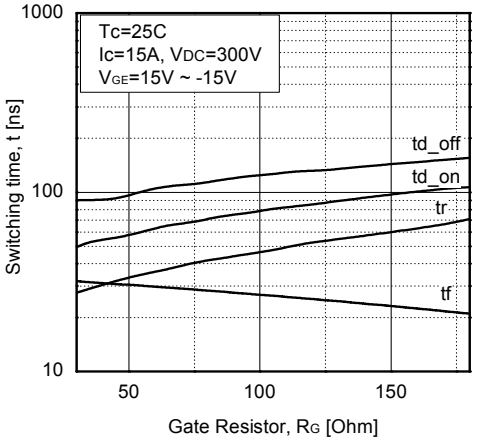


Fig12. Typical Switching Time vs RG

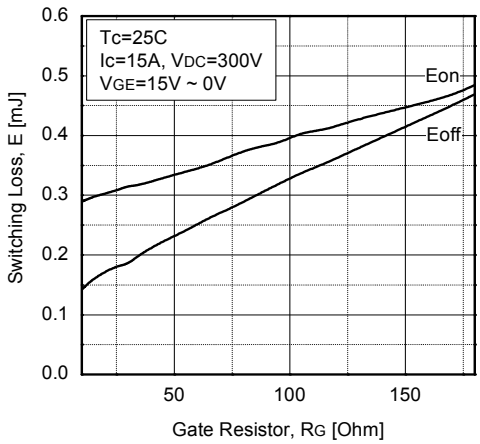


Fig13. Typical Switching Loss vs RG

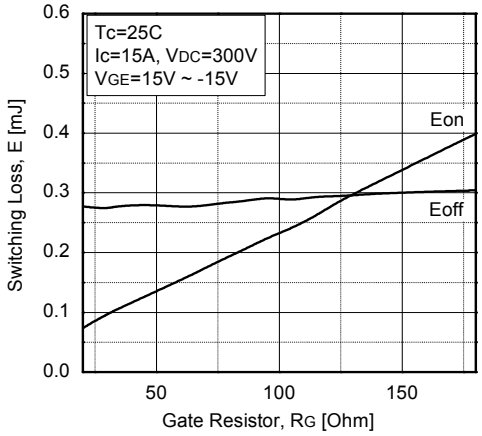


Fig14. Typical Switching Loss vs RG

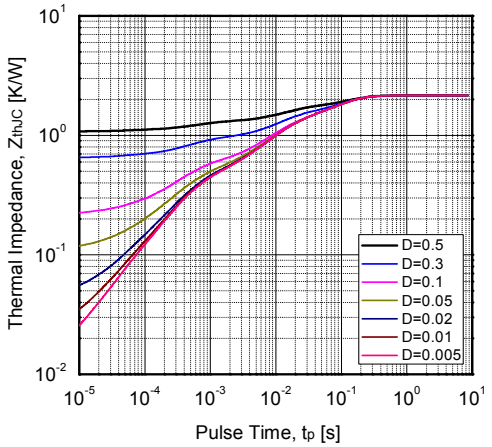


Fig15. IGBT transient thermal impedance

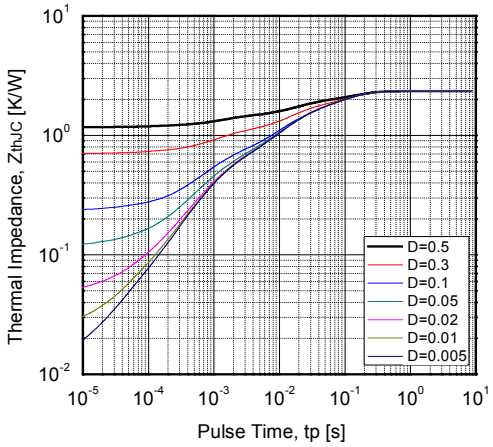


Fig16. DIODE transient thermal impedance

2. Brake IGBT/DIODE

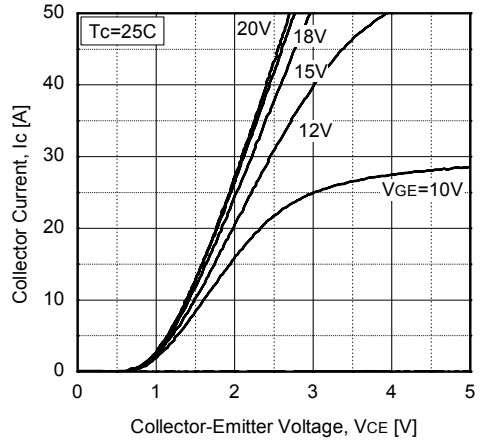


Fig 17. Typical Ouput Characteristics

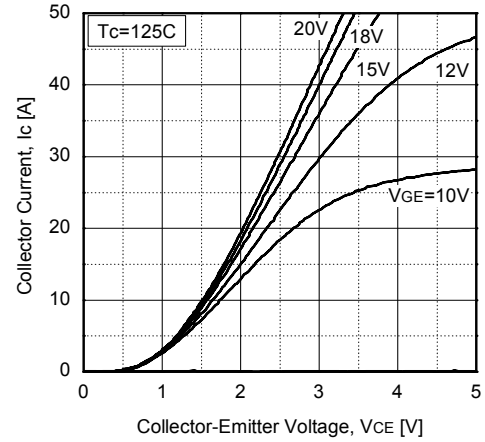


Fig 18. Typical Ouput Characteristics

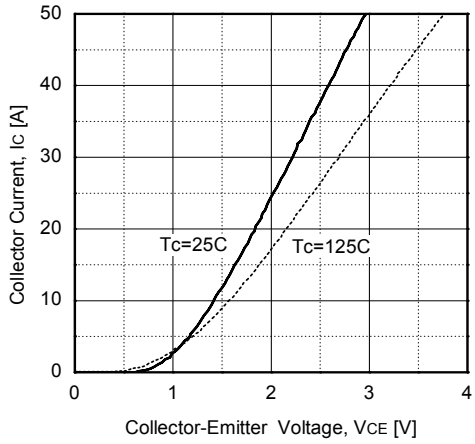


Fig 19. Typical Transfer Characteristics

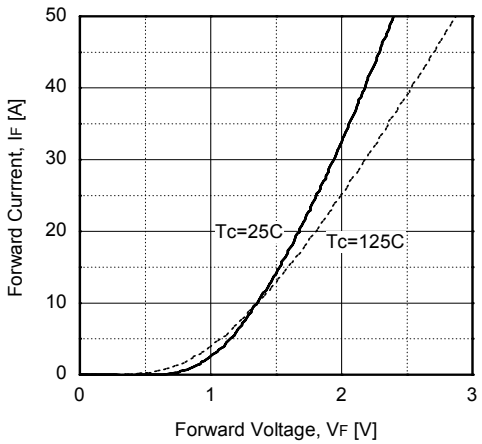


Fig 20. Typical Transfer Characteristics

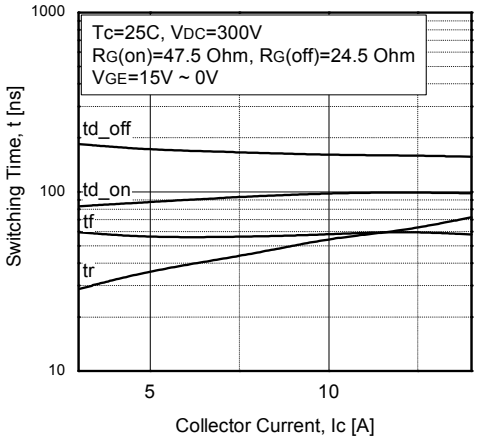


Fig 21. Typical Switching Time vs I_C

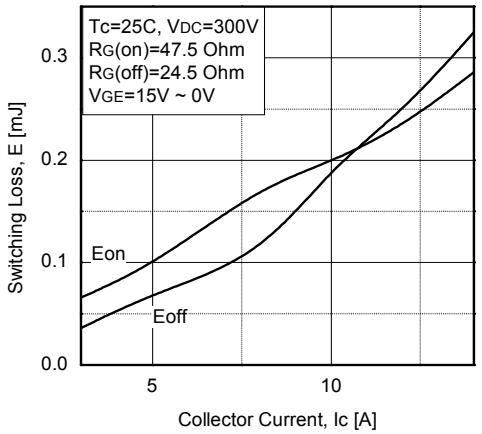


Fig 22. Typical Switching Loss & I_C

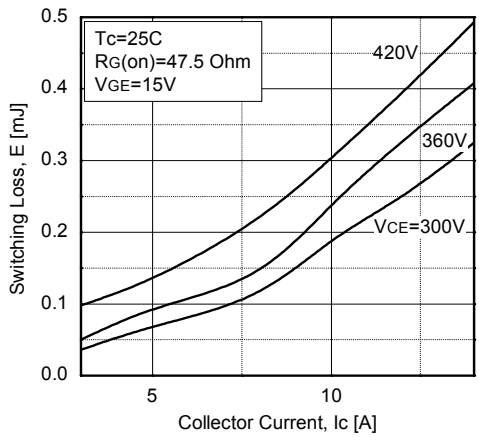


Fig 23. Typical Switching Loss(E_{on}) vs V_{CE}

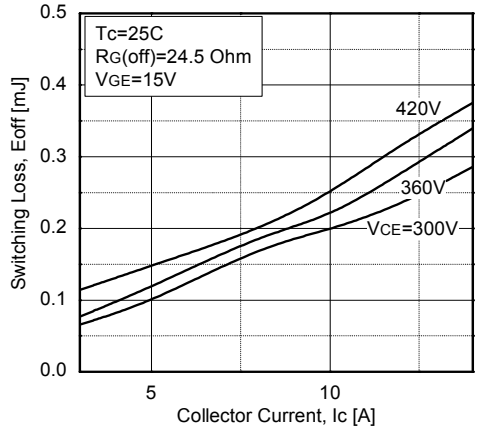


Fig 24. Typical Switching Loss(E_{off}) vs V_{CE}

3. Input Rectifier Diode

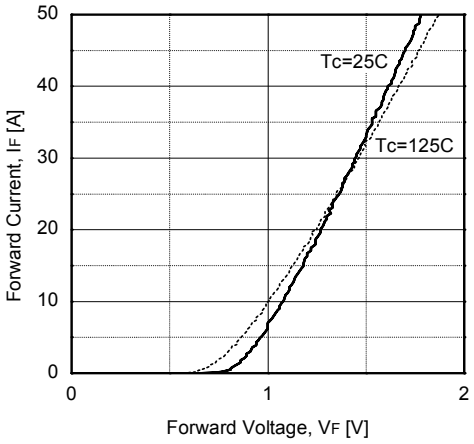


Fig 25. Typical Transfer Characteristics

Pin Description

Pin Number	Pin Name	Pin Description
1	EB	Emitter Input for Braking IGBT Driving
2	GB	Gate Input for Braking IGBT Driving
3	DCN	Negative DC Link Input
4	DCP	Positive DC Link Input
5	P	Positive DC Link Output
6	N	Negative DC Link Output
7	COM	Common Supply Ground
8	GUN	Gate Input for Low-side U Phase
9	GVN	Gate Input for Low-side V Phase
10	GWN	Gate Input for Low-side W Phase
11	TH1	NTC-, Thermistor1
12	TH2	NTC+, Thermistor2
13	U	Output for U Phase
14	V	Output for V Phase
15	W	Output for W Phase
16	EWP	Emitter Input for High-side W Phase
17	GWP	Gate Input for High-side W Phase
18	EVP	Emitter Input for High-side V Phase
19	GVP	Gate Input for High-side V Phase
20	EUP	Emitter Input for High-side U Phase
21	GUP	Gate Input for High-side U Phase
22	R	Input for R Phase
23	S	Input for S Phase
24	T	Input for T Phase
25	B	Ouput for Braking

Package Dimensions [Unit : mm]