40A, 1200V IGBT Module

DESCRIPTION

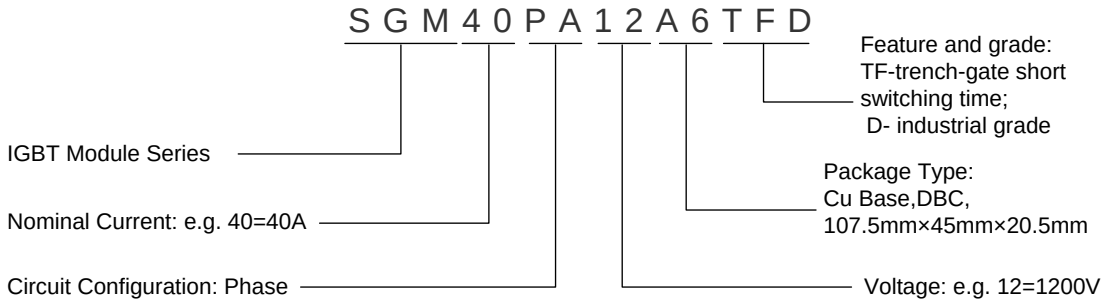
SGM40PA12A6TFD Module offers the optimum performance for Auxiliary Inverters, Air Conditioning and Motor Drives.

A6

FEATURES

- 40A, 1200V, $V_{CE(sat)(typ.)}$ =2.3V@I_C=40A
- $V_{CE(sat)}$ with positive temperature coefficient
- High short circuit capability
- Low switching loss
- Isolated using DBC technology
- With NTC

NOMENCLATURE



ORDERING INFORMATION

Part No.	Package	Marking	Packing
SGM40PA12A6TFD	A6	SGM40PA12A6TFD	Carton

ABSOLUTE MAXIMUM RATINGS OF IGBT INVERTER (T_C = 25°C,unless otherwise noted)

Characteristics	Symbol	Test conditions	Ratings	Units
Collector to Emitter Voltage	V_{CES}	T_j = 25°C	1200	V
Continuous Collector Current	$I_{C\ nom}$	T_C= 100°C, T_j max =175°C	40	A
Repetitive Pulsed Collector Current	I_{CRM}	t_P = 1 ms	80	A
Total power dissipation	P_{tot}	T_C = 25°C, T_j max =175°C	220	W
Gate-Emitter peak voltage	V_{GES}		+/-20	V

ELECTRICAL CHARACTERISTICS OF IGBT INVERTER(T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions		Min.	Typ.	Max.	Units
Collector to Emitter Saturation Voltage	V_{CEsat}	I_C=40A,V_{GE}=15V,T_j =25°C		--	2.5	3.0	V
		I_C=40A,V_{GE}=15V,T_j =125°C		--	2.9	--	
		I_C=40A,V_{GE}=15V,T_j =150°C		--	3.1	--	
Gate Threshold Voltage	V_{GEth}	I_C=250μA,V_{CE}=V_{GE}, T_j =25°C		5.0	5.5	6.5	V
C-E Leakage Current	I_{CES}	V_{CE}=1200V,V_{GE}=0V, T_j =25°C		--	--	1.0	mA
G-E Leakage Current	I_{GES}	V_{GE}=20V, V_{CE}=0V,T_j =25°C		--	--	500	nA
Integrated Gate Resistor	R_{Gint}	T_j =25°C		--	1.4	--	Ω
Input Capacitance	C_{ies}	f=400KHz,T_j=25°C, V_{CE}=25V,V_{GE}=0V		--	5810	--	pF
Output Capacitance	C_{oes}			--	626	--	
Reverse Transfer Capacitance	C_{res}			--	106	--	
Total Gate Charge	Q_G	V_{GE}=-15V---+15V		--	0.38	--	μC
Turn-On Delay Time	$t_{d(on)}$	I_C=40A,V_{CE}=600V, V_{GE}=±15V, R_G=57Ω Inductive Load	T_j =25°C	--	0.39	--	μs
			T_j =125°C	--	0.38	--	
			T_j =150°C	--	0.37	--	
Rise Time	t_r		T_j =25°C	--	0.14	--	ns
			T_j =125°C	--	0.16	--	
			T_j=150°C	--	0.17	--	
Turn-Off Delay Time	$t_{d(off)}$		T_j =25°C	--	0.49	--	ns
			T_j =125°C	--	0.50	--	
			T_j=150°C	--	0.50	--	
Fall Time	t_f		T_j =25°C	--	0.20	--	ns
			T_j =125°C	--	0.39	--	
			T_j=150°C	--	0.39	--	
Turn-On Switching Loss (per pulse)	E_{on}		T_j =25°C	--	8.85	--	mJ
			T_j =125°C	--	11.60	--	
			T_j=150°C	--	12.07	--	
Turn-Off Switching Loss(per pulse)	E_{off}		T_j =25°C	--	1.83	--	mJ
			T_j =125°C	--	2.79	--	
			T_j=150°C	--	2.88	--	
SC data	I_{SC}	V_{CC}=900V,V_{GE}≤15V, t_P≤10μs,T_j=150°C		--	226	--	A
Thermal Resistance, Junction to Case	$R_{\theta JC}$	Per IGBT		--	0.57	--	°C/W
Temperature under on-state	T_{jop}			-40	--	150	°C

ELECTRICAL CHARACTERISTICS OF FRD INVERTER(T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions	Ratings	Units
Repetitive Reverse Peak Voltage	V_{RRM}	T_j =25°C	1200	V
Continuous Forward DC Current	I_F		40	A
Repetitive Reverse Peak Current	I_{FRM}	t_P=1ms	80	A
I^2t-value	I^2t	V_R = 0V, t_P = 10 ms, T_j = 125°C	300	A^2s

ELECTRICAL CHARACTERISTICS OF FRD INVERTER (T_C=25°C,unless otherwise noted)

Characteristics	Symbol	Test conditions		Min.	Typ.	Max.	Units
Forward Voltage	V_F	I_F=40A,V_{GE}=0V	T_j =25°C	--	2.8	3.5	V
			T_j =125°C	--	2.4	--	
			T_j =150°C	--	2.4	--	
Reverse Recovery Peak Current	I_{RM}	I_F=40A, di/dt=250A/μs, V_R=600V, V_{GE}=-15V	T_j =25°C	--	19	--	A
			T_j =125°C	--	28	--	
			T_j =150°C	--	28	--	
Recovery Charge	Q_r		T_j =25°C	--	1.28	--	μC
			T_j =125°C	--	3.86	--	
			T_j =150°C	--	4.39	--	
Reverse Recovery Loss (per pulse)	E_{rec}		T_j =25°C	--	0.41	--	mJ
			T_j =125°C	--	1.52	--	
			T_j =150°C	--	1.91	--	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	Per diode		--	0.97	--	°C/W
Temperature under on-state	T_{jop}			-40	--	150	°C

ABSOLUTE MAXIMUM RATINGS OF IGBT BRAKE (T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions	Ratings	Units
Collector to Emitter Voltage	V_{CE}	T_j = 25°C	1200	V
Continuous Collector DC Current	I_{Cnom}	T_C=100°C, T_j max = 175°C	15	A
Repetitive Collector Peak Current	I_{CRM}	t_P = 1 ms	30	A
Total Power Loss	P_{tot}	T_C = 25°C, T_j max = 175°C	120	W
Gate to Emitter Peak voltage	V_{GES}		+/-20	V

ELECTRICAL CHARACTERISTICS OF IGBT BRAKE(T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions		Min.	Typ.	Max.	Units
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=15A,V_{GE}=15V T_j=25°C		--	2.4	3.0	V
		I_C=15A,V_{GE}=15V T_j=125°C		--	2.8	--	
		I_C=15A,V_{GE}=15V T_j=150°C		--	2.9	--	
Gate Threshold Voltage	$V_{GE(th)}$	I_C=250μA, V_{CE}=V_{GE}, T_j=25°C		5.0	5.8	6.5	V
Collector to Emitter Off Current	I_{CES}	V_{CE}=1200V, V_{GE}=0V,T_j=25°C		--	--	1.0	mA
Gate to Emitter Leakage Current	I_{GES}	V_{GE}=±20V, V_{CE}=0V,T_j=25°C		--	--	500	nA
Internal Gate Resistance	R_{Gint}	T_j=25°C		--	2.5	--	Ω
Input Capacitance	C_{ies}	f=400KHz,T_j=25°C,V_{CE}=25V, V_{GE}=0V		--	1780	--	pF
Output Capacitance	C_{oes}			--	194	--	
Reverse Transfer Capacitance	C_{res}			--	57	--	
Gate Charge	Q_G	V_{GE}=-15V---+15V		--	0.11	--	μC
Turn-On Delay Time	$t_{d(on)}$	I_C=15A,V_{CE}=600V , V_{GE}=±15V, R_G=68Ω Inductive load	T_j=25°C	--	0.18	--	μs
			T_j=125°C	--	0.17	--	
			T_j=150°C	--	0.13	--	
Rise Time	t_r		T_j=25°C	--	0.09	--	μs
			T_j=125°C	--	0.10	--	
			T_j=150°C	--	0.10	--	
Turn-Off Delay Time	$t_{d(off)}$		T_j=25°C	--	0.27	--	μs
			T_j=125°C	--	0.28	--	
			T_j=150°C	--	0.28	--	
Fall Time	t_f		T_j=25°C	--	0.30	--	μs
			T_j=125°C	--	0.35	--	
			T_j=150°C	--	0.35	--	
Turn-On Switching Loss(per pulse)	E_{on}		T_j=25°C	--	3.42	--	mJ
			T_j=125°C	--	4.28	--	
			T_j=150°C	--	4.29	--	
Turn-Off Switching Loss(per pulse)	E_{off}		T_j=25°C	--	0.66	--	mJ
			T_j=125°C	--	1.06	--	
			T_j=150°C	--	1.07	--	
Short-circuit Data	Isc	V_{CC}=900V,V_{GE}≤15V,t_P≤10μs,T_j =150°C		--	64	--	A
Thermal Resistance, Junction to Case	$R_{\theta JC}$	per IGBT		--	1.04	--	°C/W
Temperature under on-state	T_{jop}			-40	--	150	°C

ABSOLUTE MAXIMUM RATINGS OF FRD BRAKE (T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions	Ratings	Units
Repetitive Reverse Peak Voltage	V_{RRM}	T_j=25°C	1200	V
Continuous Forward DC Current	I_F		10	A
Repetitive Reverse Peak Current	I_{FRM}	t_P=1ms	20	A
I^2t-value	I^2t	V_R = 0V, t_P = 10 ms,T_j = 125°C	15	A^2s

ELECTRICAL CHARACTERISTICS OF FRD BRAKE (T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions		Min.	Typ.	Max.	Units
Forward Voltage	V_F	I_F = 10A,V_{GE}=0V,T_j =25°C		--	2.4	--	V
		I_F = 10A,V_{GE}=0V,T_j =125°C		--	2.1	--	
		I_F = 10A,V_{GE}=0V,T_j =150°C		--	2.0	--	
Reverse Recovery Peak Current	I_{RM}	I_F=10A, di/dt=150A/μs, V_R=600V, V_{GE}=-15V	T_j =25°C	--	9	--	A
			T_j =125°C	--	12	--	
			T_j =150°C	--	12	--	
Recovery Charge	Q_r		T_j =25°C	--	0.44	--	μC
			T_j =125°C	--	1.27	--	
			T_j =150°C	--	1.98	--	
Reverse Recovery Loss (per pulse)	E_{rec}		T_j =25°C	--	0.31	--	mJ
			T_j =125°C	--	0.59	--	
			T_j =150°C	--	0.71	--	
Thermal Resistance, Junction to Case	$R_{\theta JC}$	Per FRD		--	2.16	--	°C/W
Temperature under on-state	T_{jop}			-40	--	150	°C

ABSOLUTE MAXIMUM RATINGS OF DIODE, RECTIFIER (T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions	Ratings	Units
Repetitive Reverse Peak Voltage	V_{RRM}	T_j =25°C	1600	V
Forward Surge Current	I_{FSM}	t_p = 10 ms, T_j = 25°C	300	A
		t_p = 10 ms, T_j = 150°C	250	A
I^2t-value	I^2t	t_p = 10 ms, T_j = 25°C	450	A^2s
		t_p = 10 ms, T_j = 150°C	320	A^2s

ELECTRICAL CHARACTERISTICS OF DIODE, RECTIFIER (T_C=25°C unless otherwise noted)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Units
Forward Voltage	V_F	I_F=40A,T_j =150°C	--	1.2	--	V
Reverse Current	I_R	V_R=1600V,T_j=150°C	--	--	2.0	mA
Thermal Resistance, Junction to Case	$R_{\theta JC}$	Per Diode	--	0.82	--	°C/W

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Units
Temperature under on-state	T_{jop}		-40	--	150	°C

NTC—THERMISTOR(Specification according to the valid application note)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Units
Rated resistance	R_{25}	T_C=25°C	--	5	--	KΩ
Deviation of R100	ΔR/R	T_C = 100°C, R100 = 10mW	-5	--	5	%
B-value	$B_{25/50}$	$R_2=R_{25}$ exp [$B_{25/50}$(1/T2-1/(298,15 K))]	--	3380	--	K
B-value	$B_{25/85}$	$R_2=R_{25}$exp [$B_{25/85}$(1/T2-1/(298,15 K))]	--	3435	--	K

MODULE (T_C = 25°C, unless otherwise noted)

Characteristics	Symbol	Test conditions	Ratings	Units
Insulation test voltage	V_{ISOL}	RMS,f=50Hz,t=1min	2.5	kV
Material for internal insulation			Cu	
internal insulation		Insulation (class 1, IEC 61140)	Al_2O_3	
Creepage distance		Terminal-heatsink	10.0	mm
		Terminal - terminal	10.0	mm
Clearance distance		Terminal-heatsink	7.5	mm
		Terminal - terminal	7.5	mm
Comparative tracking index	CTI		>225	

MODULE THERMAL CHARACTERISTICS(T_C = 25°C, UNLESS OTHERWISE NOTED)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Units
Shell radiator thermal resistance	R_{thCH}	Per module		0.02		K/W
Stray inductance module	L_{sCE}		--	60	--	nH
Module lead resistance, terminal-chip	$R_{CC'+EE'}$	T_C= 25°C, per switch	--	4.0	--	mΩ
	$R_{AA'+CC'}$		--	3.0	--	mΩ
Storage temperature	T_{stg}		-40	--	125	°C
Weight	G		--	180	--	g

TYPICAL CHARACTERISTICS CURVE(IGBT, INVERTER)

Figure 1. Typical output characteristics

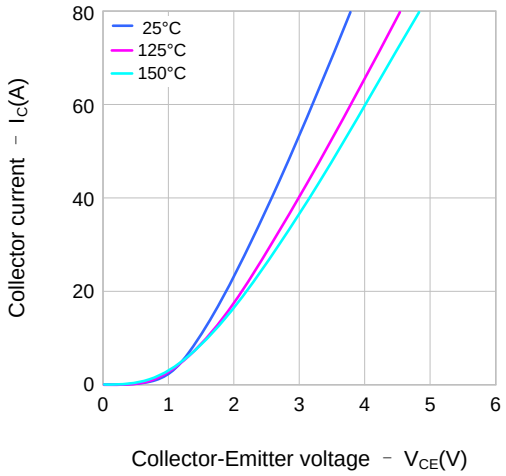


Figure 2. Typical output characteristics (150°C)

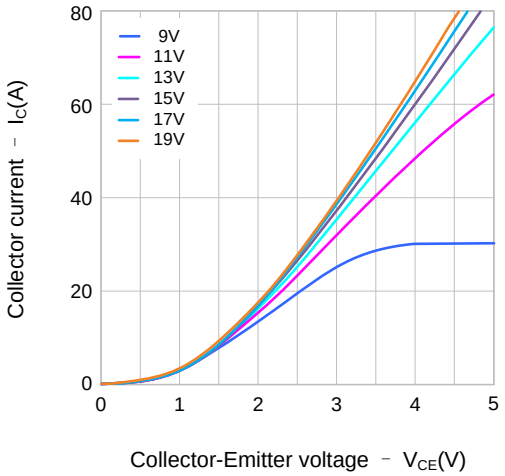


Figure 3. Transfer characteristics

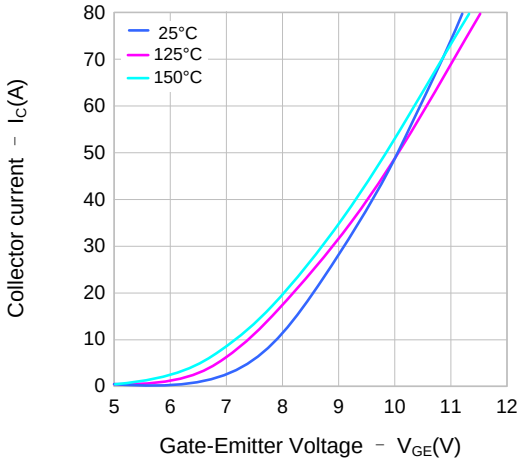


Figure 4. Switching Loss vs. Collector Current

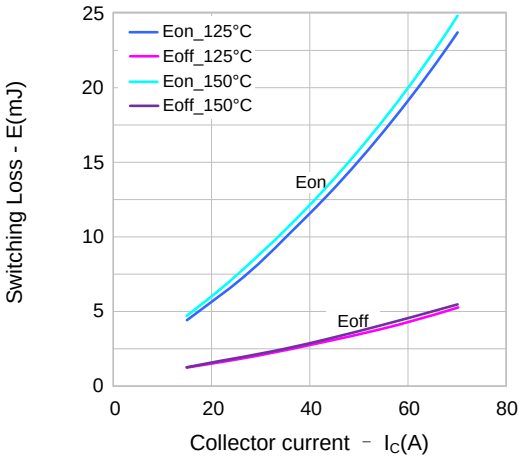


Figure 5. Switching loss vs. Gate resistance

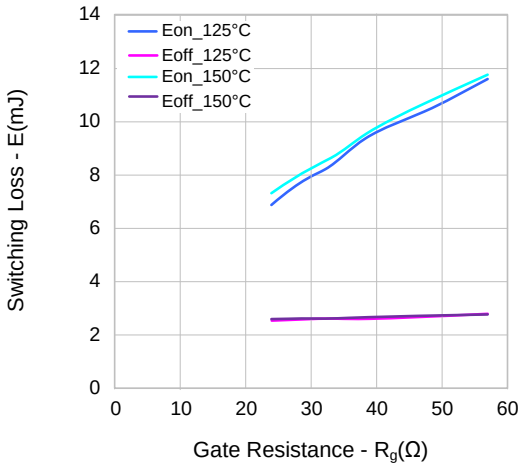
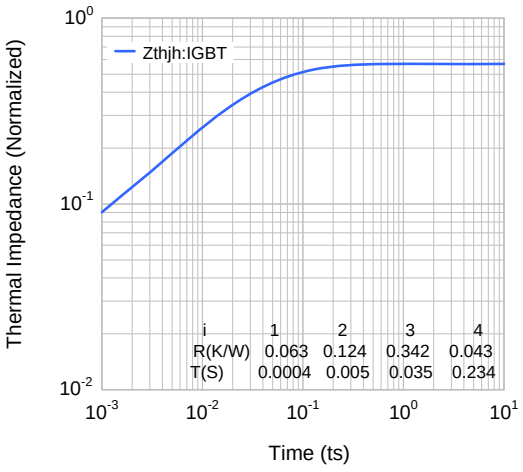
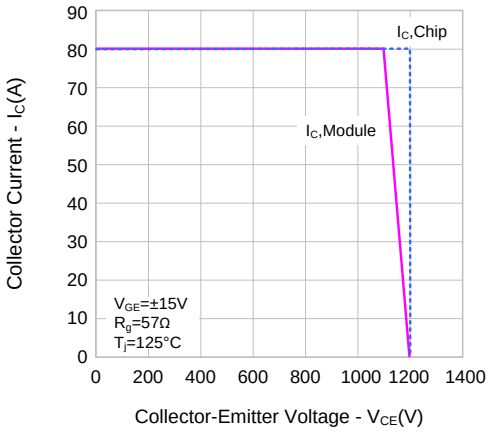


Figure 6. Transient Thermal Impedance



TYPICAL CHARACTERISTICS CURVE (IGBT, INVERTER) (CONTINUED)

Figure 7. Max. Safe Operating Area



TYPICAL CHARACTERISTICS CURVE (FRD, INVERTER) (CONTINUED)

Figure 8. Diode Forward Characteristics

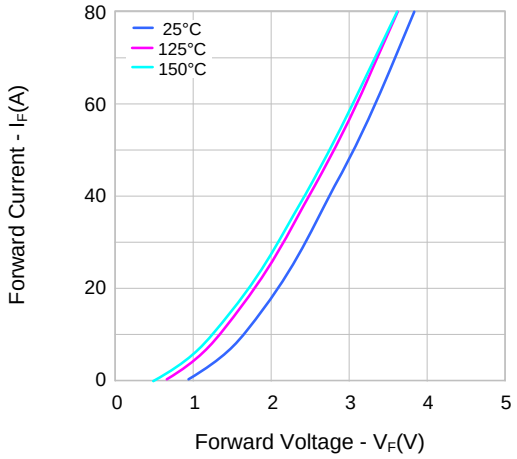


Figure 9. Switching Loss vs. Collector Current

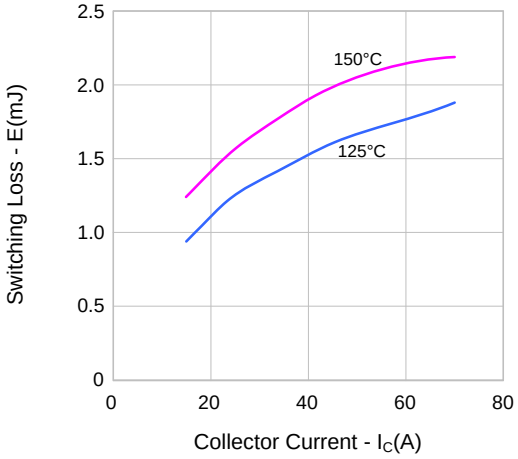


Figure 10. Switching Loss vs. Resistance

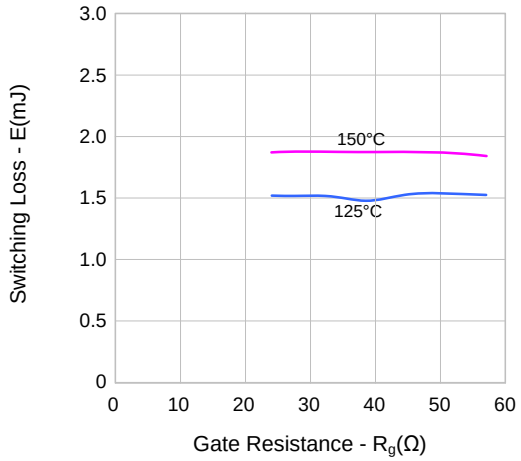
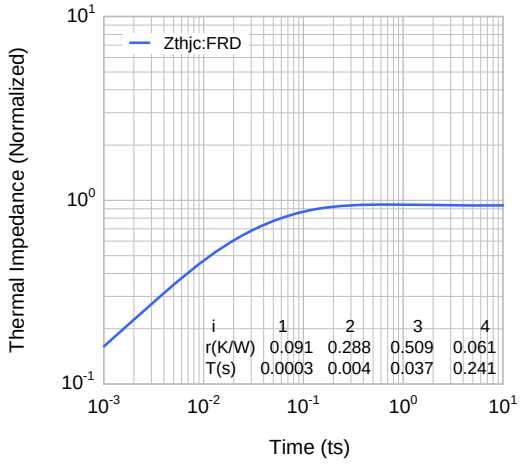
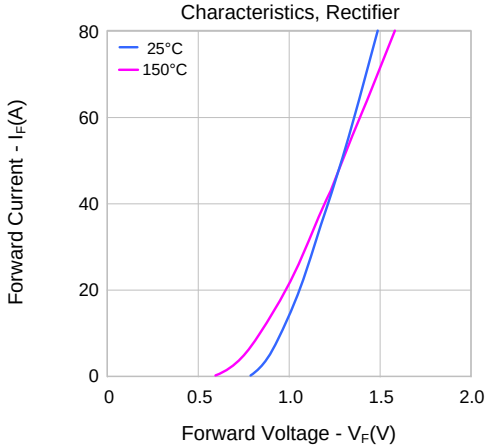


Figure 11. Transient Thermal Impedance



TYPICAL CHARACTERISTICS CURVE (DIODE, RECTIFIER)

Figure 12. Diode Forward Characteristics, Rectifier



TYPICAL CHARACTERISTICS CURVE (BRAKE)

Figure 13. Typical Output Characteristics, Brake(IGBT)

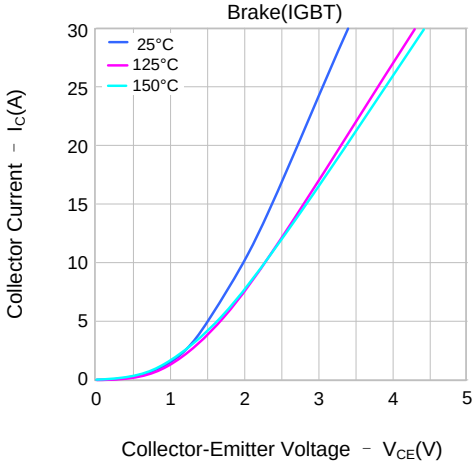
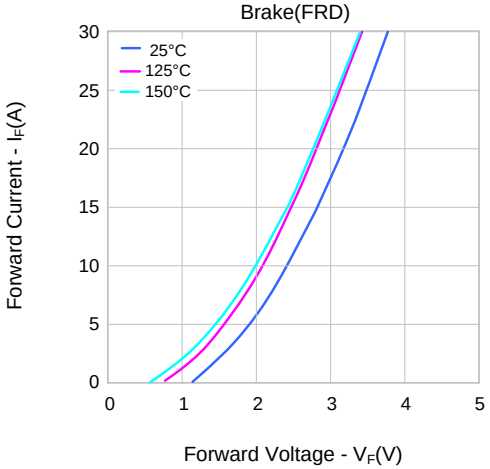
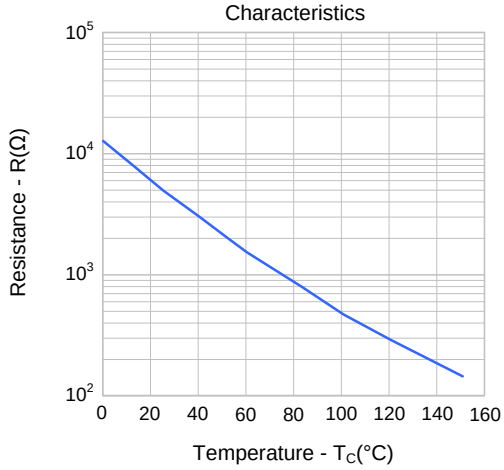


Figure 14. Diode Forward Characteristics, Brake(FRD)

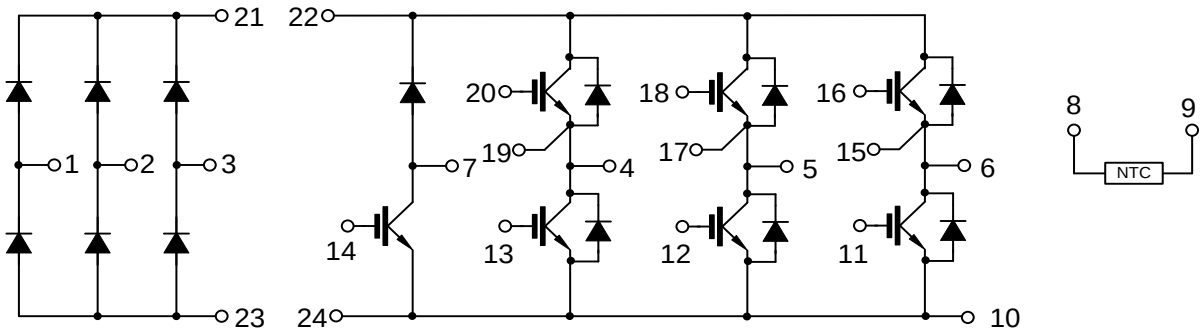


TYPICAL CHARACTERISTICS CURVE (NIC-THERMISTOR)

Figure 15. NTC-Thermistor-temperature Characteristics

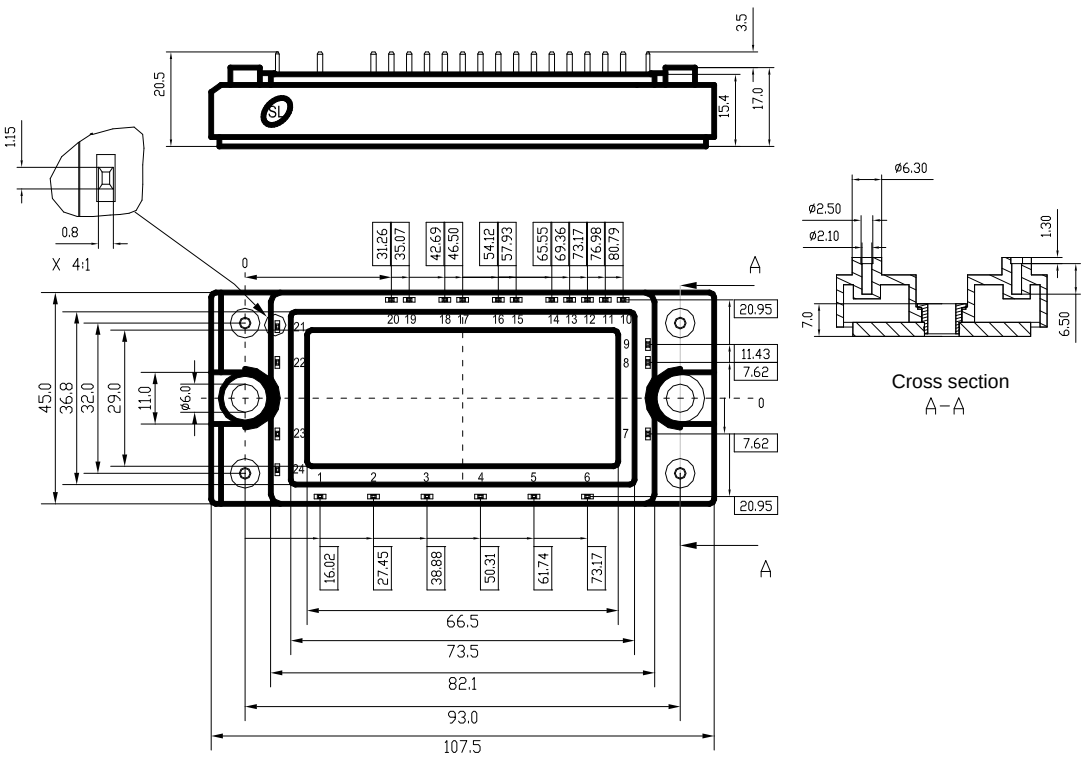


CIRCUIT DIAGRAM



PACKAGE OUTLINE

A6 **UNIT: mm**



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Part No.:	SGM40PA12A6TFD	Document Type:	Datasheet
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Rev.: 1.3

Revision History:

1. Add characteristics and curves of 150 ℃

Rev.: 1.2

Revision History:

1. Modify all the parameters
2. Modify all the curves

Rev.: 1.1

Revision History:

1. Modify the parameters of ELECTRICAL CHARACTERISTICS OFIGBT INVERTER
2. Modify the parameters of ELECTRICAL CHARACTERISTICS OF IGBT BRAKE

Rev.: 1.0

Revision History:

1. First Release