

**MCF600N120S2E3**

V_{CE}	$I_{c\ nom}$
1200V	600A

E3**DESCRIPTION**

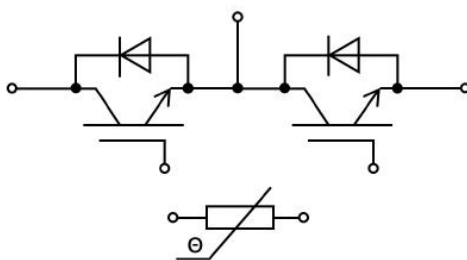
The MCF600N120S2E3 module with JSCJ advanced Trench and FS (Field Stop) IGBT provide very low Collector-Emitter Saturation Voltage, easy to use in drives and inverters.

Features

- 1200V Trench Gate & Field Stop Structure
- High Short Circuit Capability
- Low switching loss
- High Reliability
- Positive Temperature Coefficient

Application

- Solar Inverter
- Uninterrupted Power Supply
- Servo Driver
- Motor Driver

EQUIVALENT CIRCUIT

Order Code	Package	Marking	Parking
MCF600N120S2E3	E3	600N120	Module

Absolute Maximum Ratings (T_c=25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V _{CES}	Collector-Emitter Voltage	1200	V
V _{GES}	Gate-Emitter Voltage	±20	V
I _C	DC Collector Current, T _c =100°C	600	A
I _{CM}	Peak Collector Current, t _p =1ms	1200	A
I _F	Continuous Diode Forward Current	600	A
I _{FRM}	Diode Peak Forward Current, t _p =1ms	1200	A
P _D	IGBT Maximum Power Dissipation	3950	W
t _{sc}	IGBT Short Circuit Withstand Time	10	μs
T _{VJ MAX}	Maximum Junction Temperature	175	°C
T _{VJ}	Operating Junction Temperature	-40 to 150	°C
T _{STG}	Storage Temperature	-40 to 125	°C
T _L	Maximum lead temperature for soldering	260	°C

Electrical Characteristics (T_J=25°C unless otherwise noted)

Parameter	Symbol	Condition		Value			Unit
				Min	Typ.	Max	
Collector-Emitter Saturation Voltage	V _{CE(sat)}	I _C =600A	T _{vj} =25°C		1.75	2.15	V
			T _{vj} =125°C		2.20		V
			T _{vj} =150°C		2.25		V
Gate-Emitter Threshold Voltage	V _{GE(th)}	I _C =23mA, V _{CE} =V _{GE}		5.20	5.80	6.40	V
Collector-Emitter Cut-off Current	I _{CES}	V _{CE} =1200V, V _{GE} =0V				1	mA
Gate-Emitter Leakage Current	I _{GES}	V _{CE} =0V, V _{GE} =±20V		-100		100	nA
Internal Gate Resistance	R _{Gint}	T _{vj} =25°C			1.20		Ω
Gate Charge	Q _G	V _{GE} =-15V~+15V			7.4		μC
Input Capacitance	C _{ies}	V _{CE} =25V, V _{GE} =0V, f=1MHz			128		nF
Reverse Transfer Capacitance	C _{res}				1.47		nF
Turn-on Delay Time	t _{d(on)}	I _C =600A V _{CE} =600V V _{GE} =±15V R _{Gon} =1.5Ω R _{Goff} =1.5Ω Inductive Load	T _{vj} =25°C		435		ns
			T _{vj} =125°C		450		ns
			T _{vj} =150°C		450		ns
Rise Time	t _r		T _{vj} =25°C		115		ns
			T _{vj} =125°C		160		ns
			T _{vj} =150°C		170		ns
Turn-off Delay Time	t _{d(off)}		T _{vj} =25°C		625		ns
			T _{vj} =125°C		680		ns
			T _{vj} =150°C		700		ns

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Fall Time	t_f	$I_C=600A$ $V_{CE}=600V$ $V_{GE}=\pm 15V$ $R_{Gon}=1.5\Omega$ $R_{Goff}=1.5\Omega$ Inductive Load	$T_{vj}=25^{\circ}C$		90		ns
			$T_{vj}=125^{\circ}C$		200		ns
			$T_{vj}=150^{\circ}C$		235		ns
Turn-on Energy Loss	E_{on}		$T_{vj}=25^{\circ}C$		55		mJ
			$T_{vj}=125^{\circ}C$		100		mJ
			$T_{vj}=150^{\circ}C$		110		mJ
Turn-off Energy Loss	E_{off}		$T_{vj}=25^{\circ}C$		35		mJ
			$T_{vj}=125^{\circ}C$		50		mJ
			$T_{vj}=150^{\circ}C$		60		mJ
Short Circuit Current	I_{sc}	$V_{GE}\leq 15V, t_p\leq 10\mu s, V_{CC}=800V,$ $T_{vj}=150^{\circ}C$ $V_{CE,max}=V_{CES}-L_s, CE \times di/dt$			2650		A

Diode Electrical Characteristics

Parameter	Symbol	Condition		Value			Unit
				Min	Typ.	Max	
Forward Voltage	V _F	I _F =600A	T _{vj} =25°C		1.75	2.15	V
			T _{vj} =125°C		1.90		V
			T _{vj} =150°C		1.90		V
Reverse Recovery Current	I _{rr}	I _F =600A, V _R =600V, V _{GE} =-15V di _F /dt=-2700A/μs (T _{vj} =150°C)	T _{vj} =25°C		460		A
			T _{vj} =125°C		450		A
			T _{vj} =150°C		445		A
Reverse Recovery Charge	Q _{rr}		T _{vj} =25°C		50		μC
			T _{vj} =125°C		95		μC
			T _{vj} =150°C		105		μC
Reverse Recovery Energy Loss	E _{rec}		T _{vj} =25°C		12		mJ
			T _{vj} =125°C		25		mJ
			T _{vj} =150°C		30		mJ

NTC-Thermistor

Parameter	Symbol	Condition	Min	Typ.	Max	Unit
Rated resistance	R_{25}	$T_C=25^{\circ}C$		5.00		K Ω
Power dissipation	P_{25}				10	mW
B-value	$B_{25/50}$	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298,15K))]$		3375		K

Package Properties

Parameter	Symbol	Condition	Value			Unit
			Min	Typ.	Max	
IGBT Thermal Resistance: Junction to Case	$R_{th(J-C)}$	per IGBT			0.038	K/W
Diode Thermal Resistance: Junction to Case	$R_{th(J-C)}$	per Diode			0.063	K/W
IGBT Thermal Resistance: Case to Heatsink	$R_{th(C-H)}$	per IGBT $\lambda_{grease}=1W/(m \cdot K)$		0.029		K/W
Diode Thermal Resistance: Case to Heatsink	$R_{th(C-H)}$	per Diode $\lambda_{grease}=1W/(m \cdot K)$		0.048		K/W
Isolation Voltage	V_{isol}	RMS, f=50Hz, t=60s	3.4			V
Creepage Distance	d_{cr}	Terminal to Heatsink	14			mm
		Terminal to Terminal	13.5			mm
Clearance Distance	d_{cl}	Terminal to Heatsink	12.5			mm
		Terminal to Terminal	10			mm
Comparative Tracking Index	CTI		>200			
Module Stray Inductance	$L_{s, CE}$	per Switch		20		nH
Module lead Resistance, Terminal to Chip	$R_{CC'+EE'}$	per Switch, $T_C=25^{\circ}C$		1.1		mΩ
Mounting Torques	M	Baseplate to Heatsink, M5	3		6	Nm
		Power Terminal, M6	3		6	Nm
Module Weight	G			350		g

TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS

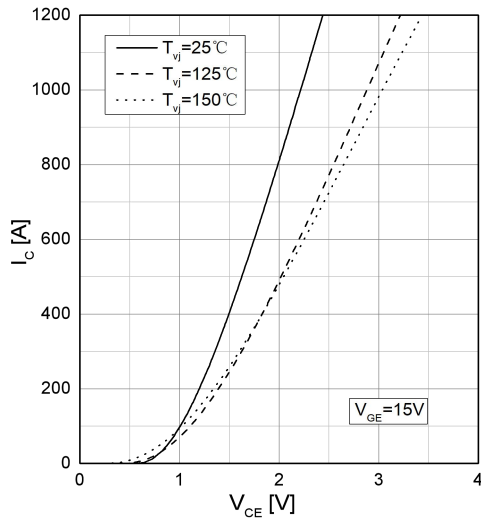


Fig.1 IGBT Output Characteristic
 I_C vs V_{CE} , $V_{GE}=15V$

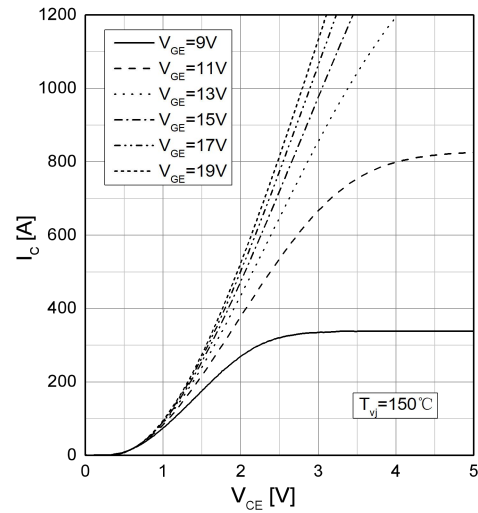


Fig.2 IGBT Output Characteristic
 I_C vs V_{CE} , $T_{vj}=150^{\circ}C$

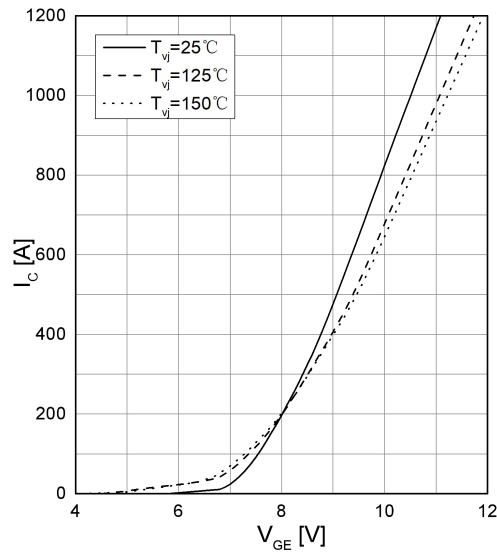


Fig.3 IGBT Transfer Characteristic
 I_C vs V_{GE} , $V_{CE}=10V$

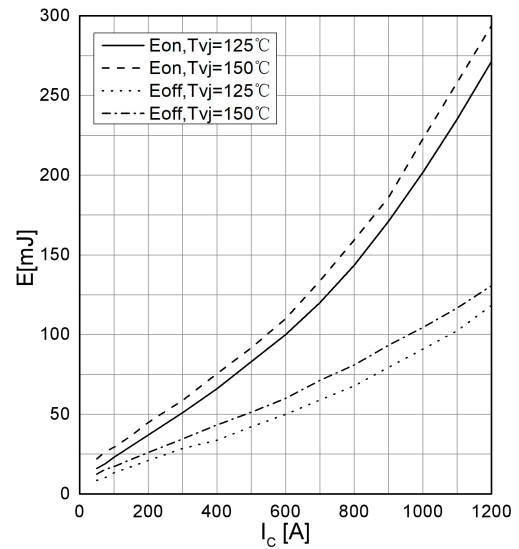


Fig.4 IGBT Switching Energy Loss
 E_{on} , E_{off} vs I_C , $V_{CE}=600V$, $V_{GE}=\pm 15V$, $R_G=1.5\Omega$

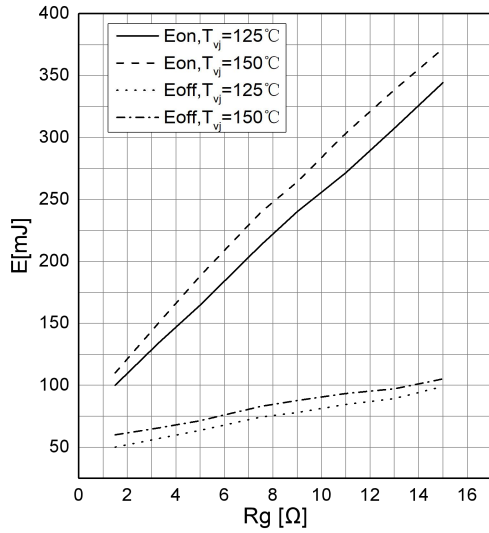


Fig.5 IGBT Switching Energy Loss
 E_{on}, E_{off} vs R_g , $I_c=600A$, $V_{CE}=600V$, $V_{GE}=\pm 15V$

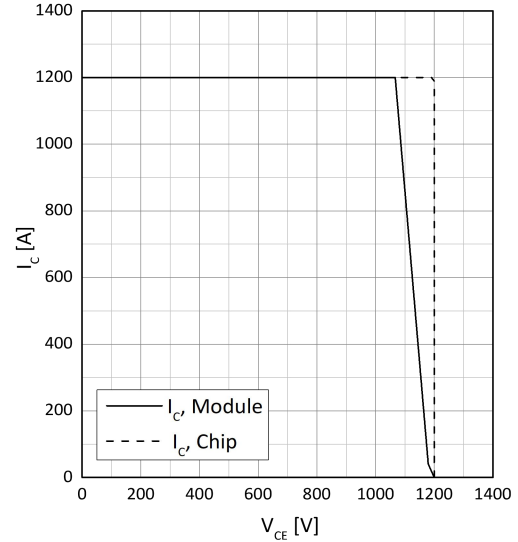


Fig.6 Reverse bias safe operating area IGBT
 $V_{GE}=\pm 15V$, $R_{Goff}=1.5\Omega$, $T_{vj}=150^\circ C$

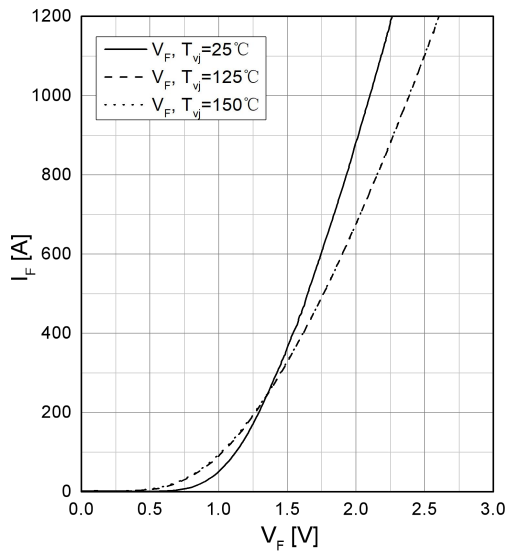


Fig.7 Diode Forward Characteristic
 I_F vs V_F

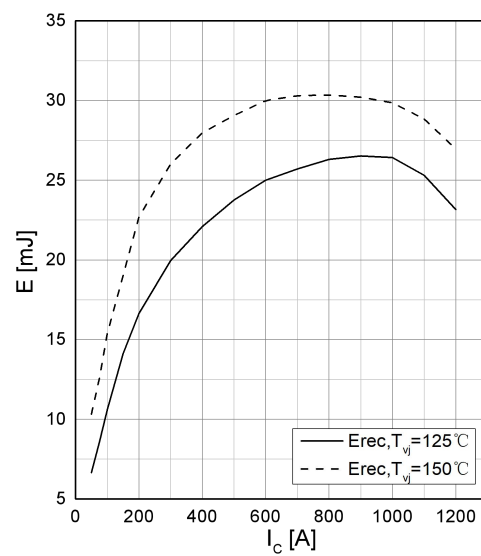


Fig.8 Diode Switching losses Diode
 E_{rec} vs I_F , $R_{Gon}=1.5\Omega$, $V_{CE}=600V$

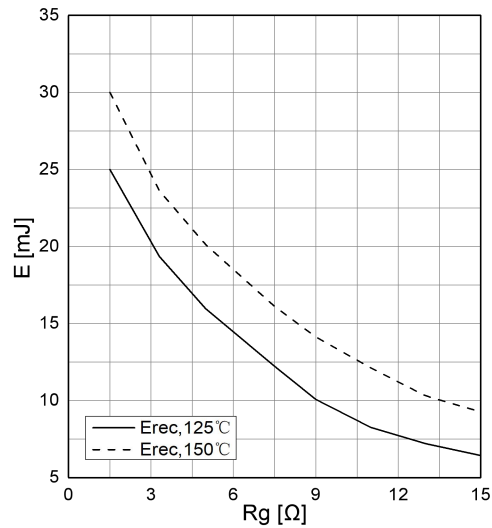


Fig.9 Diode Switching losses Diode E_{rec} vs R_g , $V_{CE}=900V$

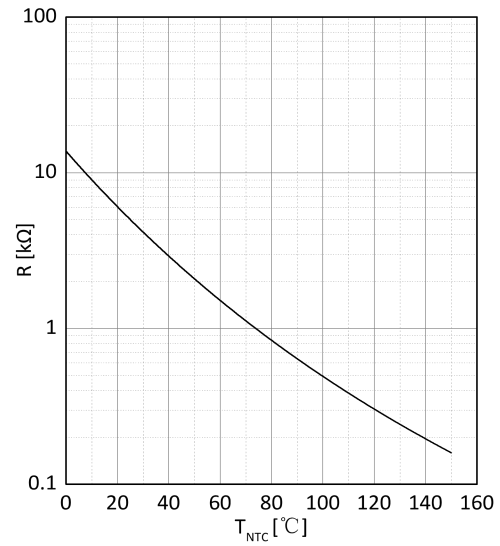


Fig.10 NTC temperature characteristic (typical) R vs T_{NTC}

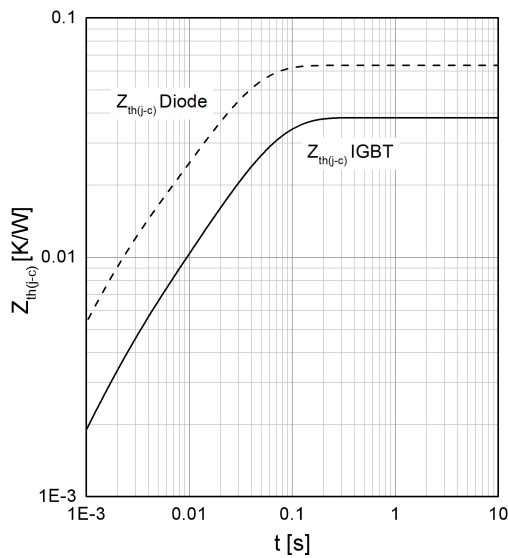


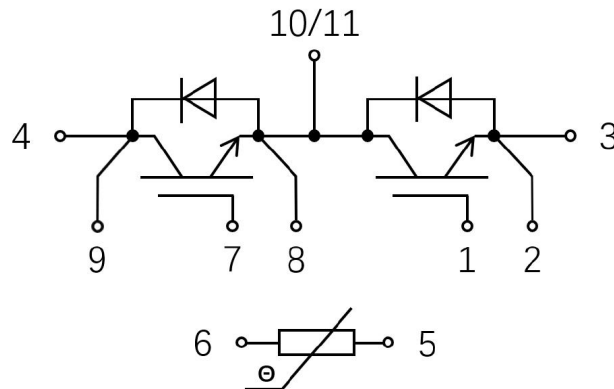
Fig.11 Transient Thermal Impedance Diode Z_{thJC} vs t

Analytical function for transient thermal impedance:

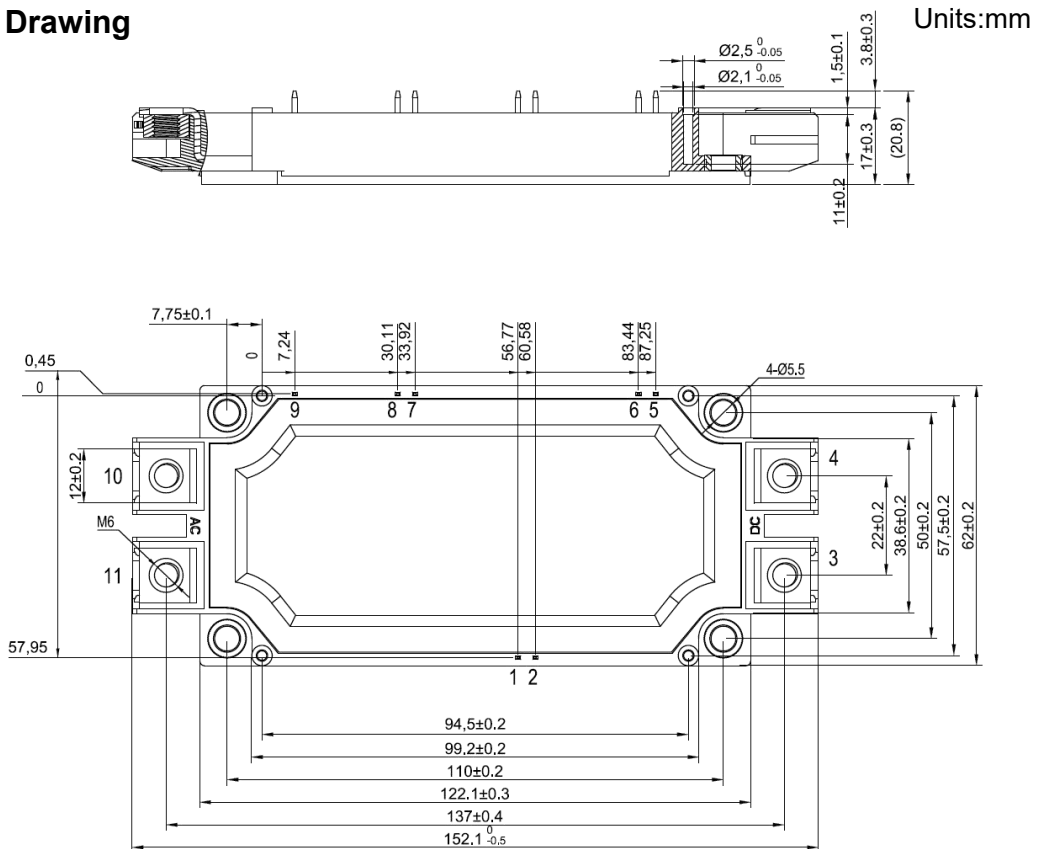
$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i (1 - e^{-t/\tau_i})$$

IGBT	i	1	2	3	4
	R_i (K/kW)	2.07	33.85	0.045	2.34
DIODE	τ_i (ms)	8.07	46.79	0.011	2.06
	R_i (K/kW)	18.21	7.41	16.16	21.58
	τ_i (ms)	28.29	1.7	24.03	28.28

Circuit Diagram



Outline Drawing



Revision History

Version	Date	Description
v1.0	2022-01-22	Preliminary Version
v2.0	2022-06-16	Formal Version