MMG600V120X6RS

1200V 600A IGBT Module

December 2023 | Preliminary | RoHS Compliant

PRODUCT FEATURES

☐ 1200V Field Stop Trench IGBT

☐ $V_{CE(sat)}$ with positive temperature coefficient

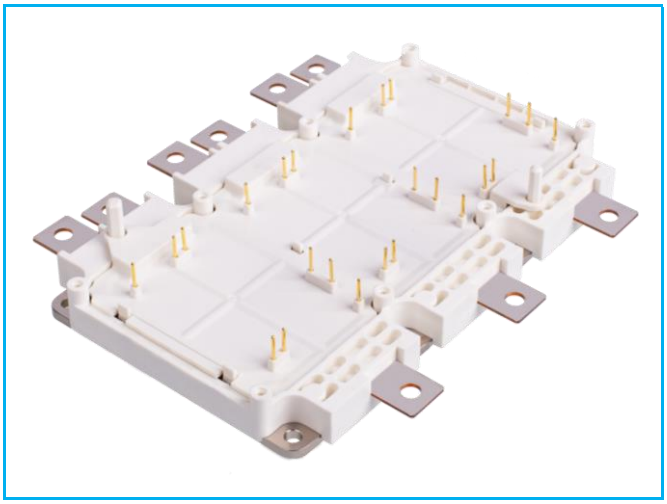
☐ Fast switching and short tail current

☐ Free wheeling diodes with fast and soft reverse recovery

☐ Max Junction Temperature 175°C

☐ Temperature sense included

☐ Isolated copper pinfin baseplate using Si_3N_4 AMB technology



APPLICATIONS

☐ Automotive Traction

IGBT-inverter

ABSOLUTE MAXIMUM RATINGS(T_F =25°C unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
V_{CES}	Collector Emitter Voltage	T_J=25℃	1200	V
V_{GES}	Gate Emitter Voltage		±20	
I_{CN}	Implemented Collector Current		600	A
I_C	Collector Current	T_F=85℃, T_{Jmax}=175℃	450	
I_{CM}	Repetitive Peak Collector Current	tp=1ms	1200	
P_D	Power Dissipation	T_F=25℃, T_{Jmax}=175℃	1500	W

Diode-inverter

ABSOLUTE MAXIMUM RATINGS (T_F =25°C unless otherwise specified)

Symbol	Parameter/Test Conditions		Values	Unit
V_{RRM}	Repetitive Reverse Voltage	T_J=25℃	1200	V
I_{FN}	Implemented Forward Current		600	A
I_F	Diode Continue Forward Current		450	
I_{FRM}	Repetitive Peak Forward Current	tp=1ms	1200	
I^2t		T_J =150℃, t=10ms, V_R=0V	14.4	kA^2s

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IGBT-inverter

ELECTRICAL CHARACTERISTICS *(T_F=25°C unless otherwise specified)*

Symbol	Parameter/Test Conditions			Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate Emitter Threshold Voltage	$V_{CE}=V_{GE}$, I_C=15.6mA		5.5	6.5	7.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C=450A, V_{GE}=15V, T_J=25℃			1.60	1.9	
		I_C=450A, V_{GE}=15V, T_J=150℃			1.85		
		I_C=450A, V_{GE}=15V, T_J=175℃			1.90		
		I_C=600A, V_{GE}=15V, T_J=25℃			1.80		
		I_C=600A, V_{GE}=15V, T_J=150℃			2.20		
		I_C=600A, V_{GE}=15V, T_J=175℃			2.25		
I_{CES}	Collector Leakage Current	V_{CE}=1200V, V_{GE}=0V, T_J=25℃				1	mA
I_{GES}	Gate Leakage Current	V_{CE}=0V,V_{GE}=±20V, T_J=25℃		-400		400	nA
R_{Gint}	Integrated Gate Resistor				1.5		Ω
Q_G	Gate Charge	V_{CE}=600V, I_C=600A , V_{GE}=±15V			1.7		μC
C_{ies}	Input Capacitance	V_{CE}=25V, V_{GE}=0V, f =100kHz			29		nF
C_{oes}	Output Capacitance				1.6		nF
C_{res}	Reverse Transfer Capacitance				0.35		nF
$t_{d(on)}$	Turn on Delay Time	V_{CC}=600V,I_C=600A R_{Gon}=1.0Ω, R_{Goff}=2.2Ω V_{GE}=±15V	T_J=25℃		140		ns
			T_J=150℃		145		ns
			T_J=175℃		150		ns
t_r	Rise Time		T_J=25℃		53		ns
			T_J=150℃		60		ns
			T_J=175℃		64		ns
$t_{d(off)}$	Turn off Delay Time	V_{CC}=600V,I_C=600A R_{Gon}=1.0Ω, R_{Goff}=2.2Ω V_{GE}=±15V	T_J=25℃		326		ns
			T_J=150℃		374		ns
			T_J=175℃		380		ns
t_f	Fall Time		T_J=25℃		198		ns
			T_J=150℃		345		ns
			T_J=175℃		371		ns
E_{on}	Turn on Energy	V_{CC}=600V,I_C=600A R_{Gon}=1.0Ω, R_{Goff}=2.2Ω V_{GE}=±15V	T_J=25℃		51.0		mJ
			T_J=150℃		79.1		mJ
			T_J=175℃		85.2		mJ
E_{off}	Turn off Energy		T_J=25℃		51.7		mJ
			T_J=150℃		75.0		mJ
			T_J=175℃		77.2		mJ
I_{SC}	Short Circuit Current	tpsc≤6μs , V_{GE}=15V T_J=150℃,V_{CC}=800V			2200		A
R_{thJF}	Junction to cooling fluid, △V/△t = 10 dm³/min, T_F = 25°C （Per IGBT）					0.10	K /W

Diode-inverter

ELECTRICAL CHARACTERISTICS *(T_F=25°C unless otherwise specified)*

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
V_F	Forward Voltage	I_F=450A , V_{GE}=0V, T_J=25℃		1.90	2.3	V
		I_F=450A , V_{GE}=0V, T_J=150℃		2.10		
		I_F=450A , V_{GE}=0V, T_J=175℃		2.05		
		I_F=600A , V_{GE}=0V, T_J=25℃		2.10		
		I_F=600A , V_{GE}=0V, T_J=150℃		2.40		
		I_F=600A , V_{GE}=0V, T_J=175℃		2.35		
Q_{RR}	Reverse Recovery Charge	I_F=600A , V_R=600V dI_F/dt=-9700A/μs T_J =25℃		29.5		μC
I_{RRM}	Max. Reverse Recovery Current			402		A
E_{rec}	Reverse Recovery Energy			19.5		mJ
Q_{RR}	Reverse Recovery Charge	I_F=600A , V_R=600V dIF/dt=-8700A/μs TJ =150℃		79		μC
I_{RRM}	Max. Reverse Recovery Current			453		A
E_{rec}	Reverse Recovery Energy			37.0		mJ
Q_{RR}	Reverse Recovery Charge	I_F=600A , V_R=600V dIF/dt=-8300A/μs TJ =175℃		80		μC
I_{RRM}	Max. Reverse Recovery Current			458		A
E_{rec}	Reverse Recovery Energy			39.2		mJ
R_{thJF}	Junction to cooling fluid, △V/△t = 10 dm³/min, T_F = 25°C （ Per Diode）				0.14	K /W

NTC CHARACTERISTICS *(T_F=25°C unless otherwise specified)*

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
R_{25}	Resistance	T_F =25℃		5		kΩ
△R/R	T_C=100℃， R_{100}=0.493kΩ		-5		5	%
$B_{25/50}$	$R_2 = R_{25}$ exp [$B_{25/50}$(1/T_2 - 1/(298.15 K))]			3375		K

MODULE CHARACTERISTICS *(T_F=25°C unless otherwise specified)*

Symbol	Parameter/Test Conditions		Values	Unit
T_{Jmax}	Max. Junction Temperature		175	℃
T_{Jop}	Operating Temperature		-40~150	
T_{stg}	Storage Temperature		-40~125	
V_{isol}	Isolation Breakdown Voltage	RMS, f=50Hz, t=60sec	2600	V
CTI	Comparative Tracking Index		﹥200	
Torque	baseplate to heatsink	Recommended（M4）	1.8~2.2	Nm
	PCB to frame	Recommended（M3）	0.65~0.75	Nm
Weight			775	g

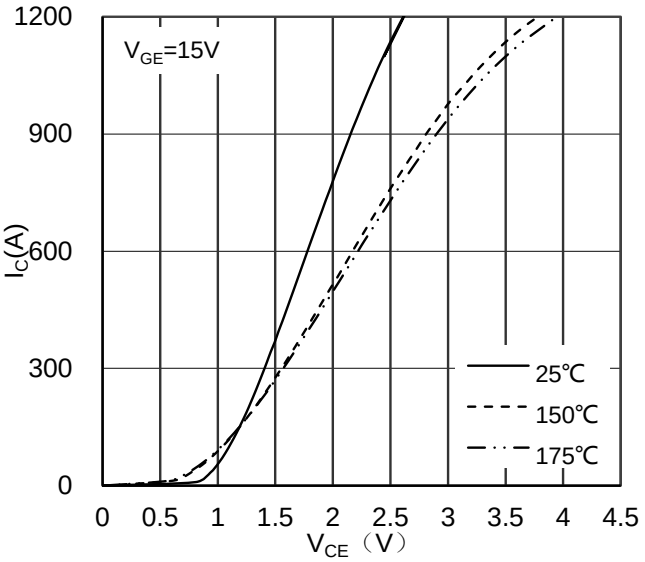


Figure 1. Typical Output Characteristics IGBT-inverter

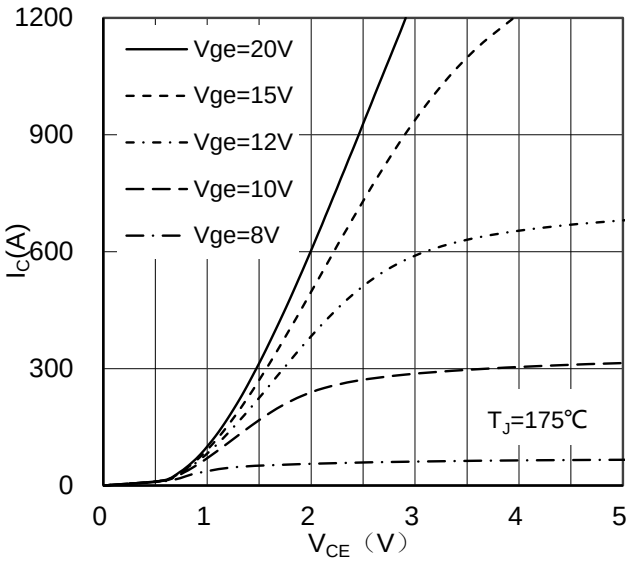


Figure 2. Typical Output Characteristics IGBT-inverter

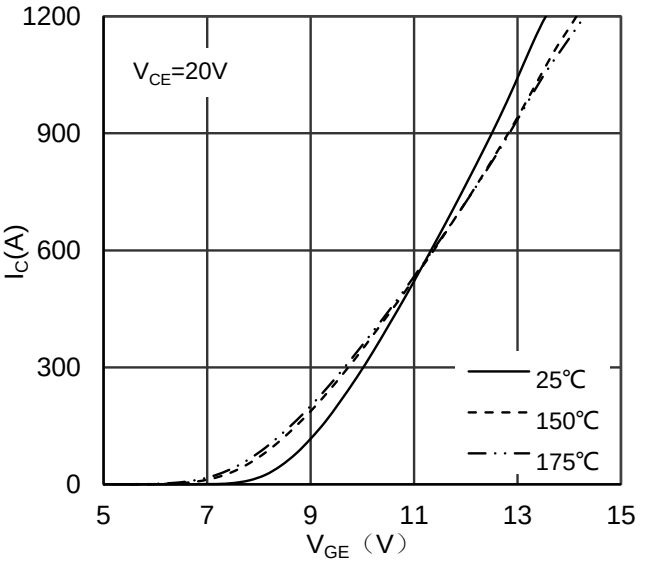


Figure 3. Typical Transfer characteristics IGBT-inverter

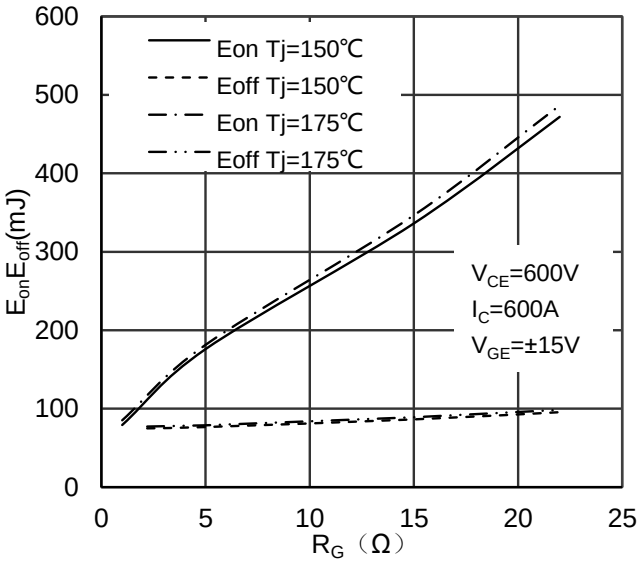


Figure 4. Switching Energy vs Gate Resistor IGBT-inverter

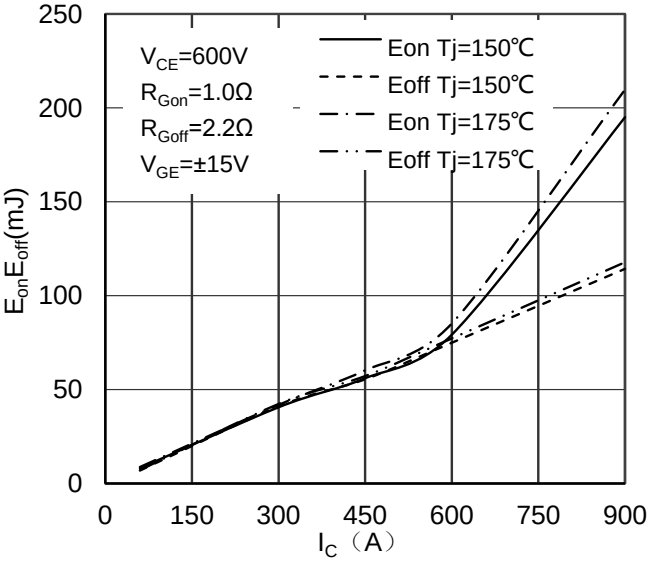


Figure 5. Switching Energy vs Collector Current IGBT-inverter

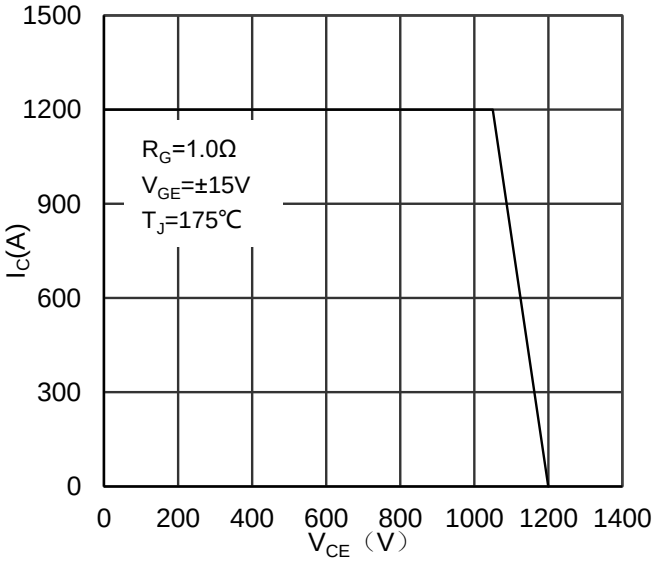


Figure 6. Reverse Biased Safe Operating Area IGBT-inverter

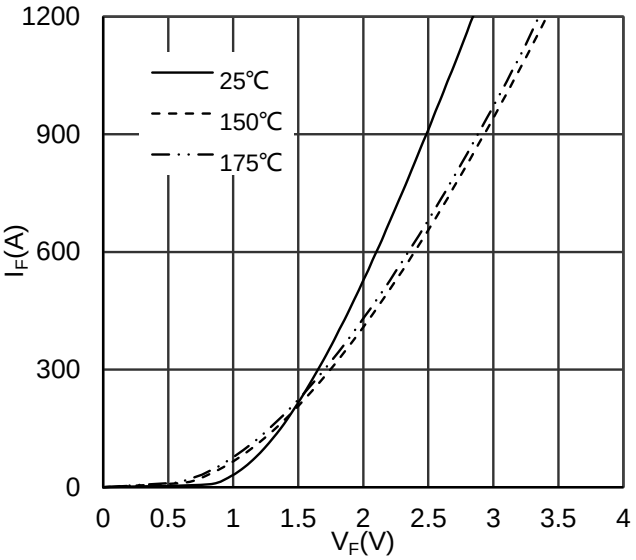


Figure 7. Diode Forward Characteristics Diode-inverter

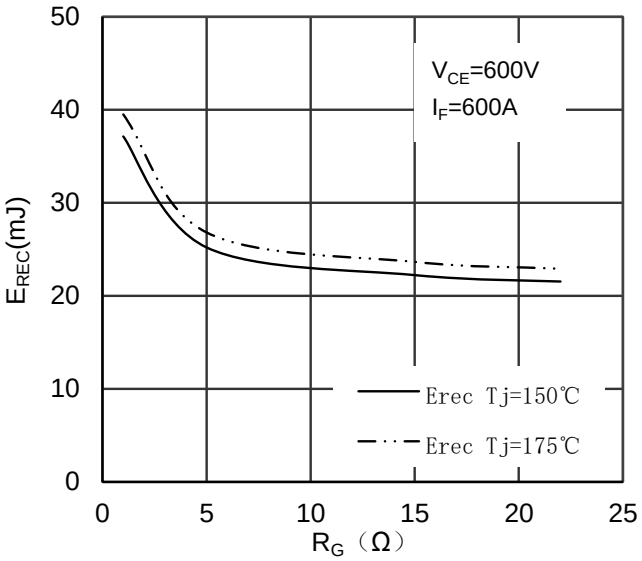


Figure 8. Switching Energy vs Gate Resistor Diode-inverter

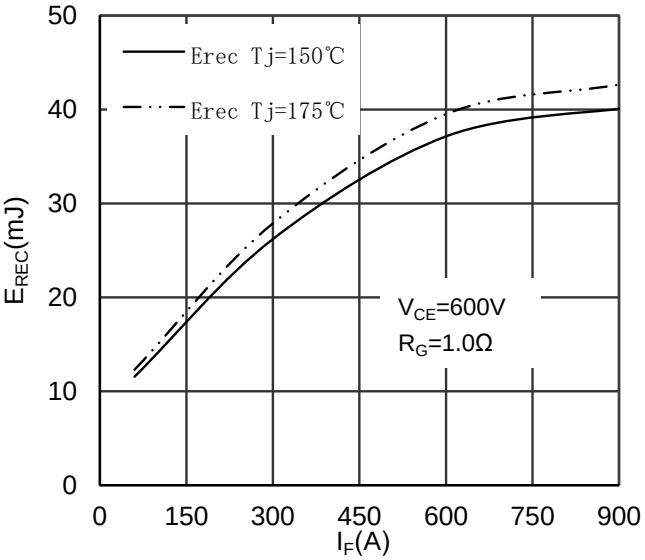


Figure 9. Switching Energy vs Forward Current Diode-inverter

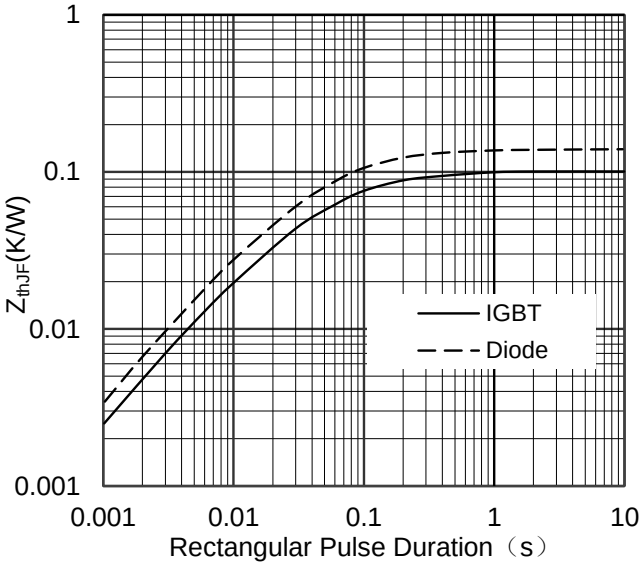


Figure 10. Transient Thermal Impedance of Diode and IGBT-inverter

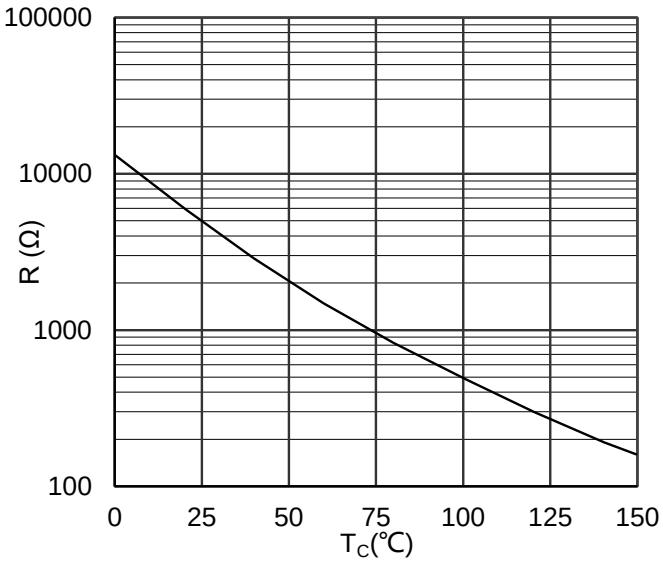


Figure 11. NTC Characteristics

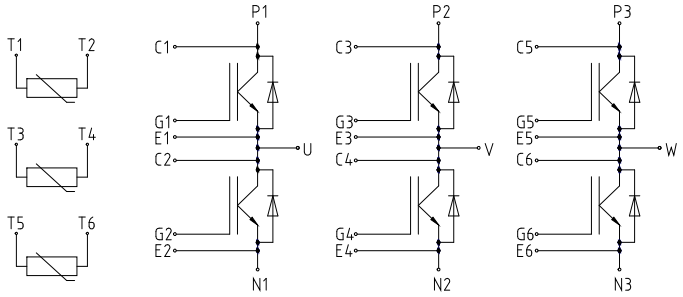
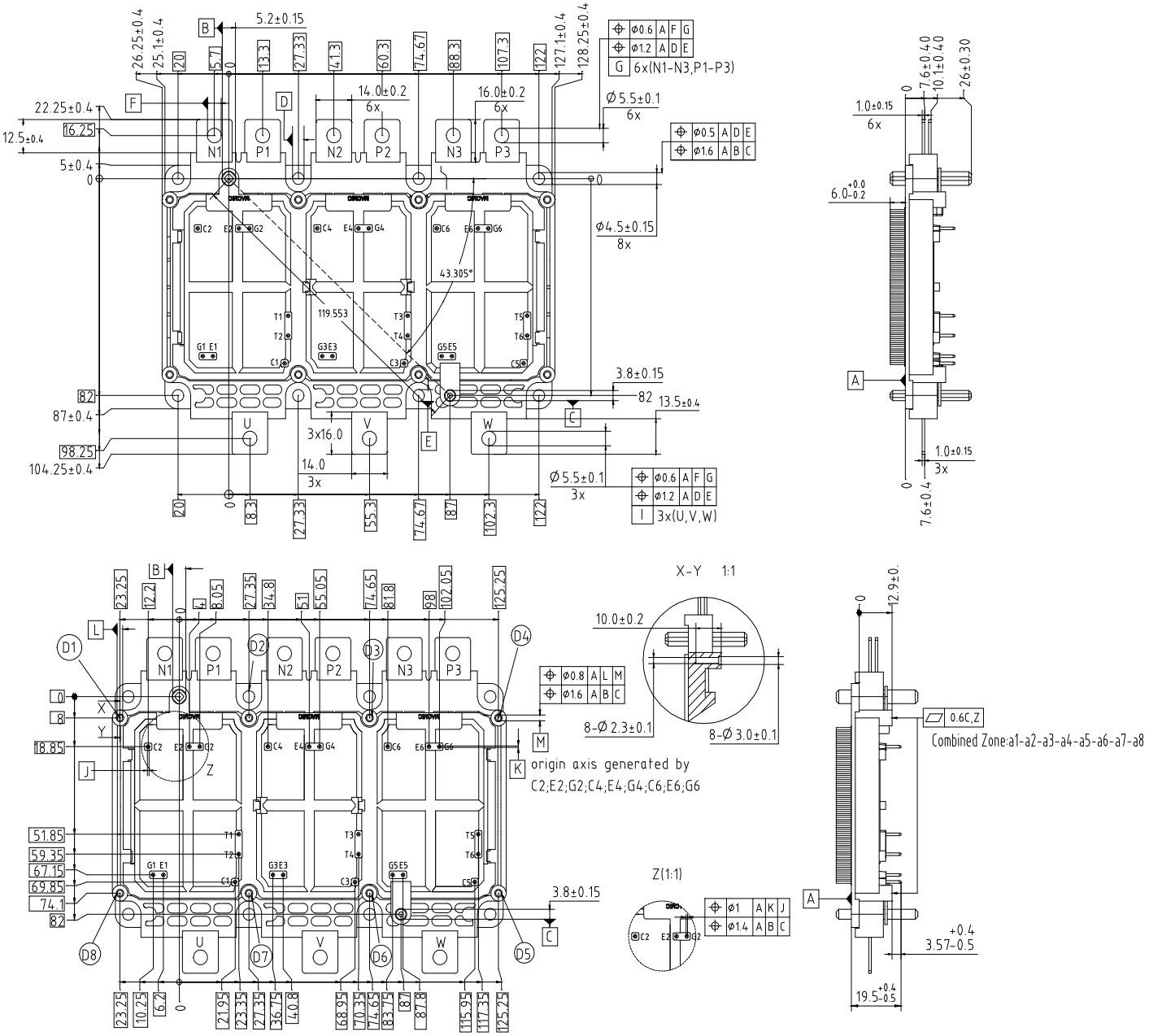


Figure 12. Circuit Diagram



Dimensions in (mm)

Figure 13. Package Outline