MMG560WQ120BF6T7

1200V 560A Three Level Inverter Module

July 2024 | Preliminary | RoHS Compliant

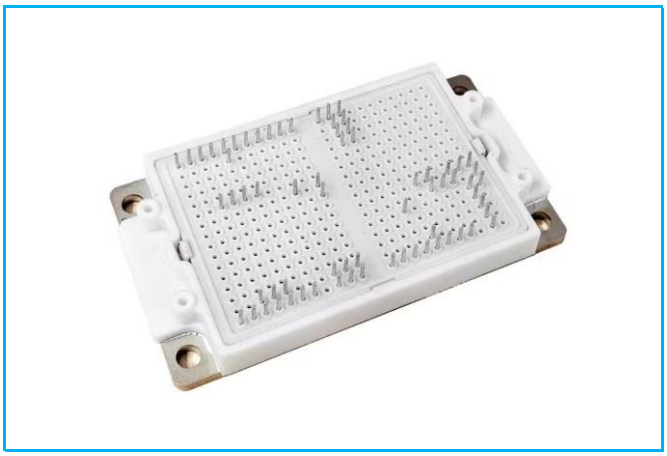
PRODUCT FEATURES

☐ 1200V IGBT CHIP

☐ Low VCE(sat) and Low switching losses

☐ Free wheeling diodes with fast and soft reverse recovery

☐ PressFIT contact technology



APPLICATIONS

☐ 3-Level-Applications

☐ Solar Applications

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

Symbol	Parameter/Test Conditions		Values	Unit
T_{Jop}	Operating Temperature		-40~150	℃
T_{stg}	Storage Temperature		-40~125	
V_{isol}	Isolation Breakdown Voltage	AC, 50Hz(R.M.S), t=1minute	3200	V
RTI	RTI Elec.	housing	140	℃
CTI	Comparative Tracking Index		>400	
Md	Mounting Torque	Recommended（M5）	2.5~5	Nm

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IGBT(T1、T4)

ABSOLUTE MAXIMUM RATINGS(T_C *=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		560	A
I_{CDC}	Continuous DC Collector Current	T_C=25℃,T_{Jmax}=175℃	735	
		T_C=100℃,T_{Jmax}=175℃	460	
I_{CM}	Repetitive Peak Collector Current	tp=1ms	1120	
T_{Jmax}	Max. Junction Temperature		175	℃
P_{tot}	Power Dissipation Per IGBT	T_C=25℃,T_{Jmax}=175℃	1666	W

ELECTRICAL CHARACTERISTICS *(T_C =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=2.24mA		4.55	5.35	6.15	V
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	I_C=600A, V_{GE}=15V, T_J=25℃			1.51	2.00	
		I_C=600A, V_{GE}=15V, T_J=125℃			1.81		
		I_C=600A, V_{GE}=15V, T_J=150℃			1.90		
I_{CES}	Collector Leakage Current	V_{CE}=1200V, V_{GE}=0V, T_J=25℃				100	μA
I_{GES}	Gate Leakage Current	V_{CE}=0V,V_{GE}=±20V, T_J=25℃		-400		400	nA
R_{Gint}	Integrated Gate Resistor				1.2		Ω
Q_G	Gate Charge	V_{CE}=400V, I_C=300A , V_{GE}=15V			2.7		μC
C_{ies}	Input Capacitance	V_{CE}=25V, V_{GE}=0V, f =100kHz			85		nF
C_{oes}	Output Capacitance				1.5		nF
C_{res}	Reverse Transfer Capacitance				395		pF
$t_{d(on)}$	Turn on Delay Time	V_{CC}=400V,I_C=300A R_{Gon} =10Ω, V_{GE}=±15V, Inductive Load di/dt=2100A/μs （T_J=150℃）	T_J=25℃		440		ns
			T_J=125℃		440		ns
			T_J=150℃		440		ns
t_r	Rise Time		T_J=25℃		130		ns
			T_J=125℃		154		ns
			T_J=150℃		160		ns
E_{on}	Turn on Energy		T_J=25℃		17.8		mJ
			T_J=125℃		23.5		mJ
			T_J=150℃		26.3		mJ
$t_{d(off)}$	Turn off Delay Time	V_{CC}=400V,I_C=300A R_{Goff} =10Ω, V_{GE}=±15V, Inductive Load dv/dt=3800V/μs （T_J=150℃）	T_J=25℃		2120		ns
			T_J=125℃		2200		ns
			T_J=150℃		2250		ns
t_f	Fall Time		T_J=25℃		88		ns
			T_J=125℃		110		ns
			T_J=150℃		121		ns
E_{off}	Turn off Energy		T_J=25℃		15.7		mJ
			T_J=125℃		18.7		mJ
			T_J=150℃		20.1		mJ
R_{thJC}	Junction to Case Thermal Resistance					0.09	K /W

IGBT(T2、T3)

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

Symbol	Parameter/Test Conditions		Values	Unit
V_{CES}	Collector Emitter Voltage	T_J=25℃	650	V
V_{GES}	Gate Emitter Voltage		±20	
I_{CN}	Implemented Collector Current		400	A
I_{CDC}	Continuous DC Collector Current	T_C=25℃,T_{Jmax}=175℃	465	
		T_C=100℃,T_{Jmax}=175℃	285	
I_{CM}	Repetitive Peak Collector Current	tp=1ms	800	
T_{Jmax}	Max. Junction Temperature		175	℃
P_{tot}	Power Dissipation Per IGBT	T_C=25℃,T_{Jmax}=175℃	833	W

ELECTRICAL CHARACTERISTICS *(T_C =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=4mA		3.20	3.95	4.70	V
$V_{CE(sat)}$	Collector Emitter Saturation Voltage	I_C=400A, V_{GE}=15V, T_J=25℃			1.45	2.00	
		I_C=400A, V_{GE}=15V, T_J=125℃			1.60		
		I_C=400A, V_{GE}=15V, T_J=150℃			1.65		
I_{CES}	Collector Leakage Current	V_{CE}=650V, V_{GE}=0V, T_J=25℃				100	μA
I_{GES}	Gate Leakage Current	V_{CE}=0V,V_{GE}=±20V, T_J=25℃		-400		400	nA
R_{Gint}	Integrated Gate Resistor				0.4		Ω
Q_G	Gate Charge	V_{CE}=400V, I_C=400A , V_{GE}=15V			0.8		μC
C_{ies}	Input Capacitance	V_{CE}=25V, V_{GE}=0V, f =100kHz			28		nF
C_{oes}	Output Capacitance				1.3		nF
C_{res}	Reverse Transfer Capacitance				200		pF
$t_{d(on)}$	Turn on Delay Time	V_{CC}=400V,I_C=400A R_{Gon} =15Ω, V_{GE}=±15V, Inductive Load di/dt=3600A/μs （T_J=150℃）	T_J=25℃		130		ns
			T_J=125℃		135		ns
			T_J=150℃		135		ns
t_r	Rise Time		T_J=25℃		120		ns
			T_J=125℃		126		ns
			T_J=150℃		132		ns
E_{on}	Turn on Energy		T_J=25℃		13.2		mJ
			T_J=125℃		20.0		mJ
			T_J=150℃		21.5		mJ
$t_{d(off)}$	Turn off Delay Time	V_{CC}=400V,I_C=400A R_{Goff} =15Ω, V_{GE}=±15V, Inductive Load dv/dt=7200V/μs （T_J=150℃）	T_J=25℃		605		ns
			T_J=125℃		620		ns
			T_J=150℃		625		ns
t_f	Fall Time		T_J=25℃		77		ns
			T_J=125℃		83		ns
			T_J=150℃		83		ns
E_{off}	Turn off Energy		T_J=25℃		17.1		mJ
			T_J=125℃		18.6		mJ
			T_J=150℃		18.9		mJ
R_{thJC}	Junction to Case Thermal Resistance					0.178	K /W

Diode(D1)

ABSOLUTE MAXIMUM RATINGS (T_C *=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		420	A
I_{FRM}	Repetitive Peak Forward Current	tp=1ms	840	
T_{Jmax}	Max. Junction Temperature		150	℃

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

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
V_F	Forward Voltage	I_F=420A , V_{GE}=0V, T_J=25℃		2.60	3.20	V
		I_F=420A , V_{GE}=0V, T_J=125℃		2.24		
		I_F=420A , V_{GE}=0V, T_J=150℃		2.13		
t_{rr}	Reverse Recovery Time	I_F=400A , V_R=400V dI_F/dt=-3600A/μs T_J =150℃		215		ns
I_{RRM}	Max. Reverse Recovery Current			274		A
Q_{RR}	Reverse Recovery Charge			27.4		μC
E_{rec}	Reverse Recovery Energy			12.5		mJ
R_{thJC}	Junction to Case Thermal Resistance				0.190	K /W

Diode(D4)

ABSOLUTE MAXIMUM RATINGS (T_C *=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		560	A
I_{FRM}	Repetitive Peak Forward Current	tp=1ms	1120	
T_{Jmax}	Max. Junction Temperature		150	℃

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

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
V_F	Forward Voltage	I_F=560A , V_{GE}=0V, T_J=25℃		2.60	3.20	V
		I_F=560A , V_{GE}=0V, T_J=125℃		2.24		
		I_F=560A , V_{GE}=0V, T_J=150℃		2.13		
t_{rr}	Reverse Recovery Time	I_F=400A , V_R=400V dI_F/dt=-3600A/μs T_J =150℃		213		ns
I_{RRM}	Max. Reverse Recovery Current			280		A
Q_{RR}	Reverse Recovery Charge			27.5		μC
E_{rec}	Reverse Recovery Energy			12.5		mJ
R_{thJC}	Junction to Case Thermal Resistance				0.143	K /W

Diode(D2、D3)

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

Symbol	Parameter/Test Conditions		Values	Unit
V_{RRM}	Repetitive Reverse Voltage	T_J=25℃	650	V
I_{FN}	Implemented Forward Current		375	A
I_{FRM}	Repetitive Peak Forward Current	tp=1ms	750	
T_{Jmax}	Max. Junction Temperature		150	℃

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

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
V_F	Forward Voltage	I_F=375A , V_{GE}=0V, T_J=25℃		1.75	2.30	V
		I_F=375A , V_{GE}=0V, T_J=125℃		1.6		
		I_F=375A , V_{GE}=0V, T_J=150℃		1.55		
t_{rr}	Reverse Recovery Time	I_F=300A , V_R=400V dI_F/dt=-2000A/μs T_J =150℃		240		ns
I_{RRM}	Max. Reverse Recovery Current			105		A
Q_{RR}	Reverse Recovery Charge			14		μC
E_{rec}	Reverse Recovery Energy			6.3		mJ
R_{thJC}	Junction to Case Thermal Resistance				0.142	K /W

Diode(D2-1、D3-1)

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

Symbol	Parameter/Test Conditions		Values	Unit
V_{RRM}	Repetitive Reverse Voltage	T_J=25℃	650	V
I_{FN}	Implemented Forward Current		75	A
I_{FRM}	Repetitive Peak Forward Current	tp=1ms	150	
T_{Jmax}	Max. Junction Temperature		150	℃

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

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
V_F	Forward Voltage	I_F=75A , V_{GE}=0V, T_J=25℃		1.75	2.3	V
		I_F=75A , V_{GE}=0V, T_J=125℃		1.6		
		I_F=75A , V_{GE}=0V, T_J=150℃		1.55		
R_{thJC}	Junction to Case Thermal Resistance				0.71	K /W

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

Symbol	Parameter/Test Conditions		Min.	Typ.	Max.	Unit
R_{25}	Resistance	T_C =25℃		22		kΩ
△R/R	T_{NTC}=100℃， R_{100}=1.486kΩ		-5		5	%
$B_{25/50}$	$R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298.15\ K))]$			3950		K

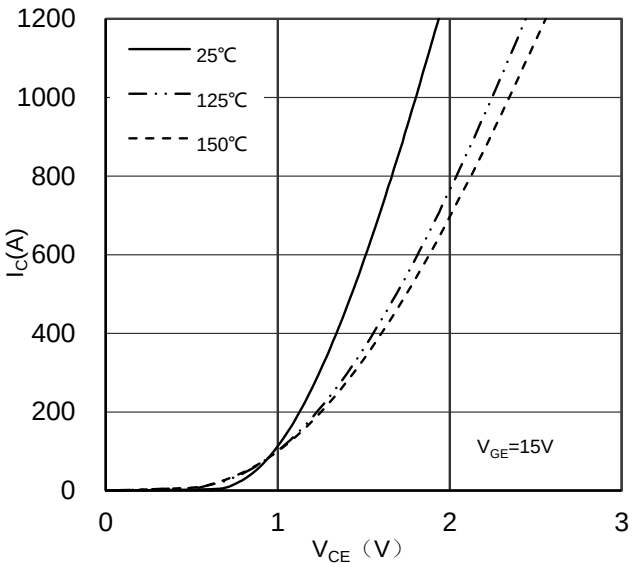


Figure 1. Typical Output Characteristics IGBT
（T1、T4）

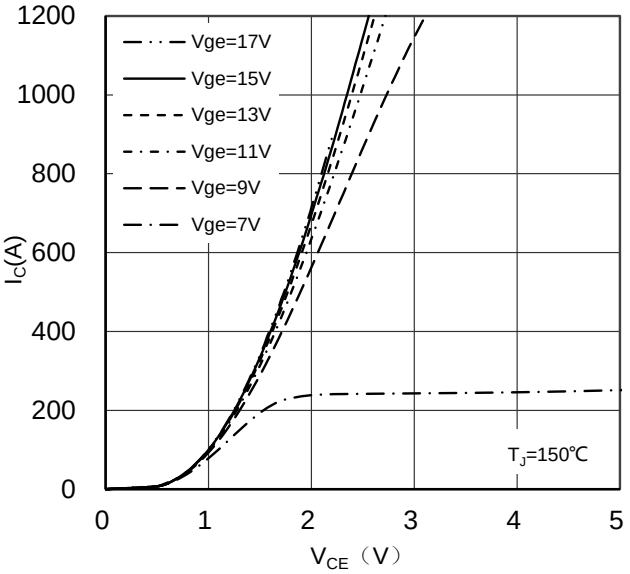


Figure 2. Typical Output Characteristics IGBT
（T1、T4）

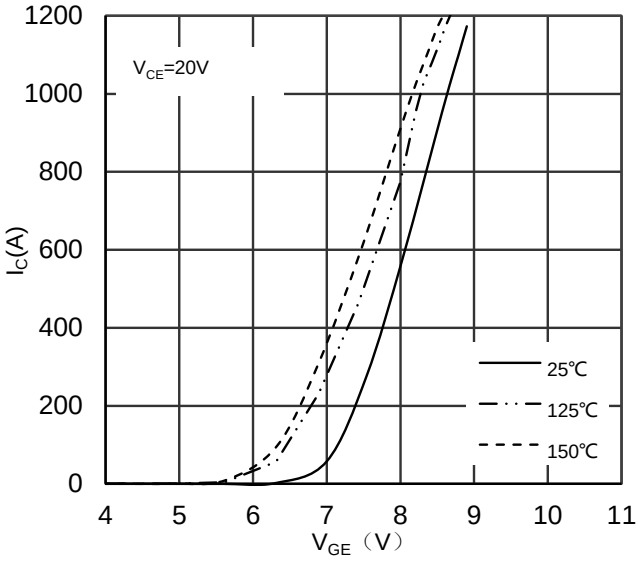


Figure 3. Typical Transfer characteristics IGBT
（T1、T4）

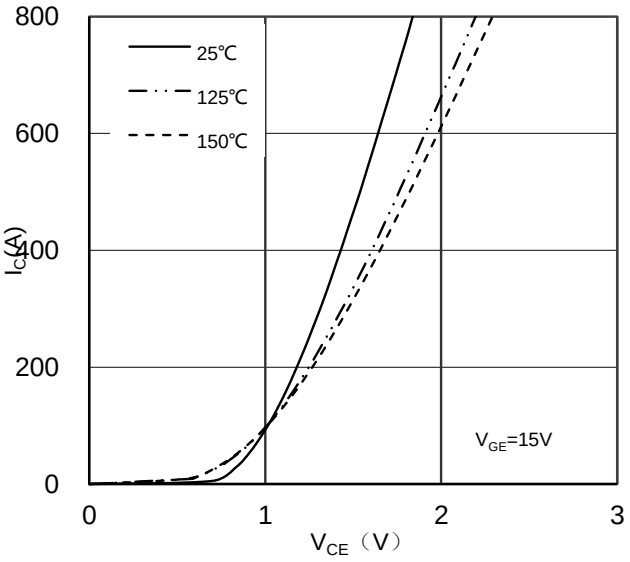


Figure 4. Typical Output Characteristics IGBT
（T2、T3）

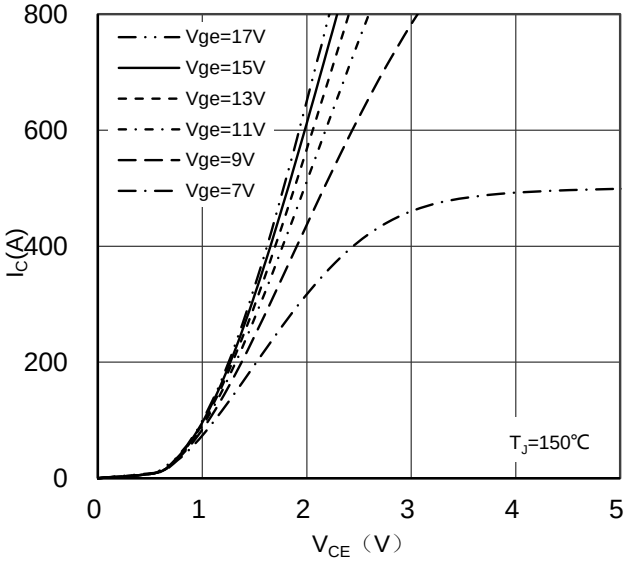


Figure 5. Typical Output Characteristics IGBT
（T2、T3）

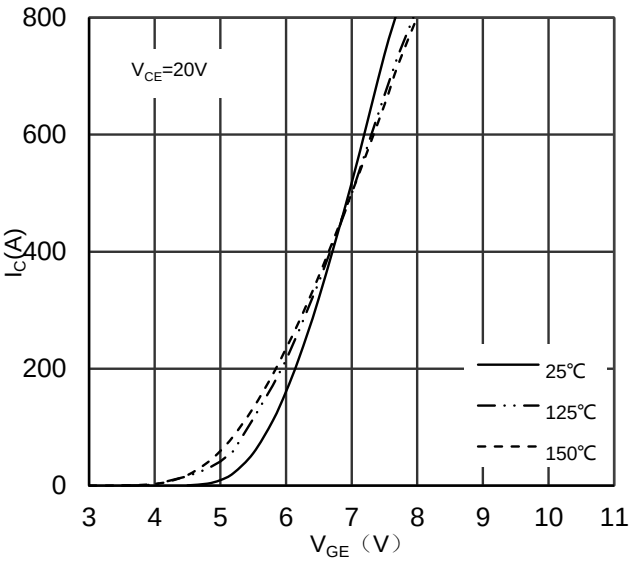


Figure 6. Typical Transfer characteristics IGBT
（T2、T3）

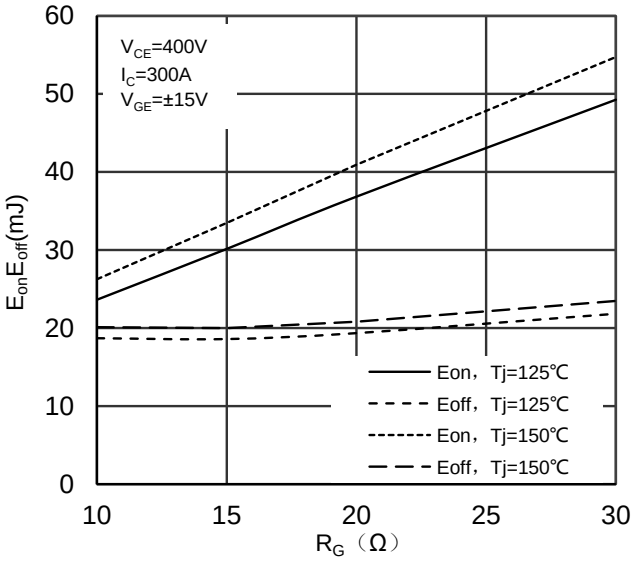


Figure 7. Switching Energy vs Gate Resistor IGBT
（T1、T4）

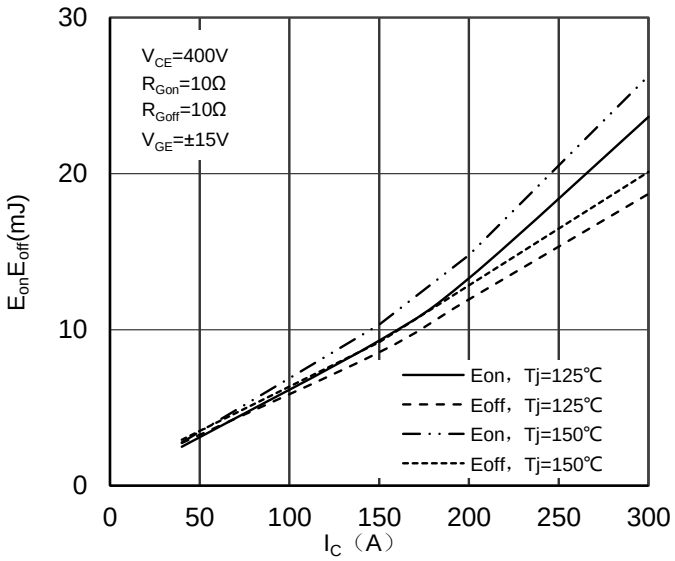


Figure 8. Switching Energy vs Collector Current IGBT
（T1、T4）

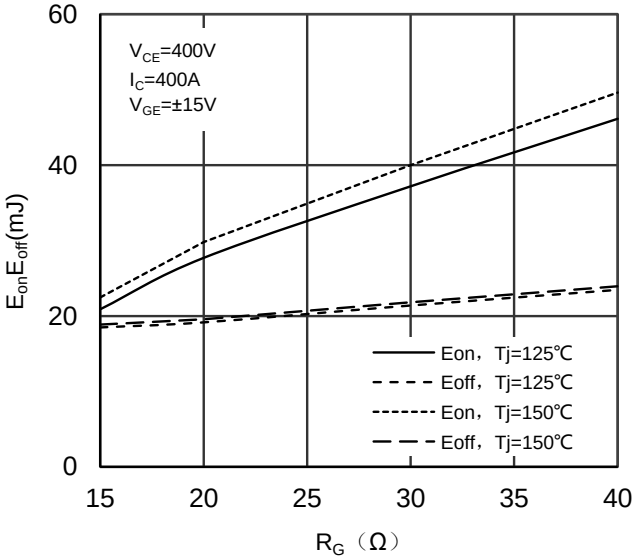


Figure 9. Switching Energy vs Gate Resistor IGBT
（T2、T3）

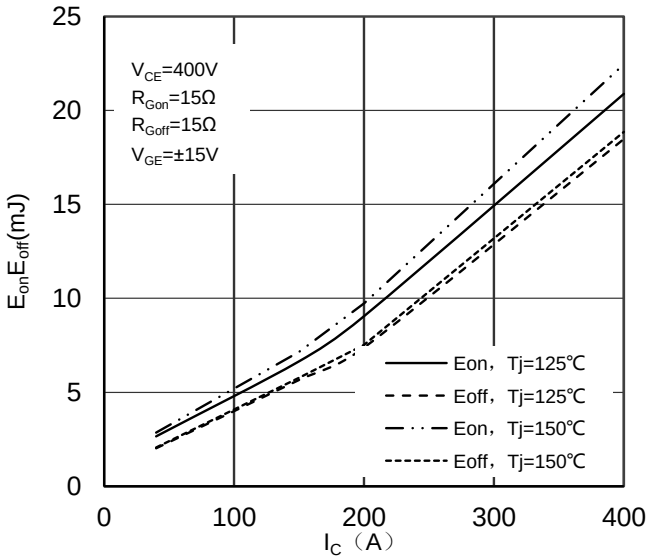


Figure 10. Switching Energy vs Collector Current IGBT
（T2、T3）

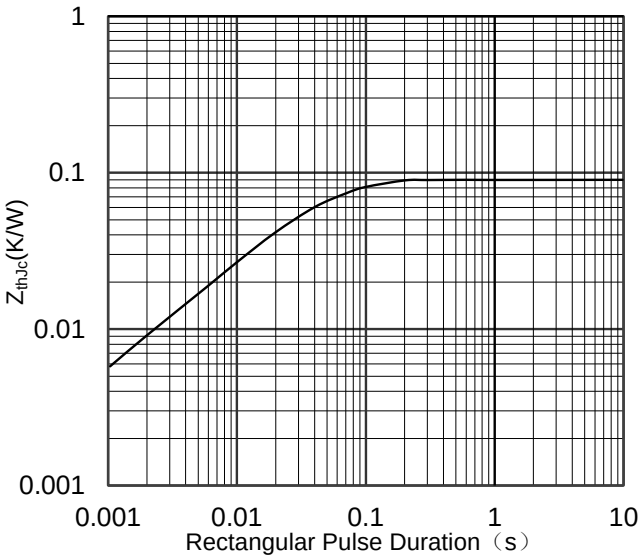


Figure 11. Transient Thermal Impedance of IGBT
（T1、T4）

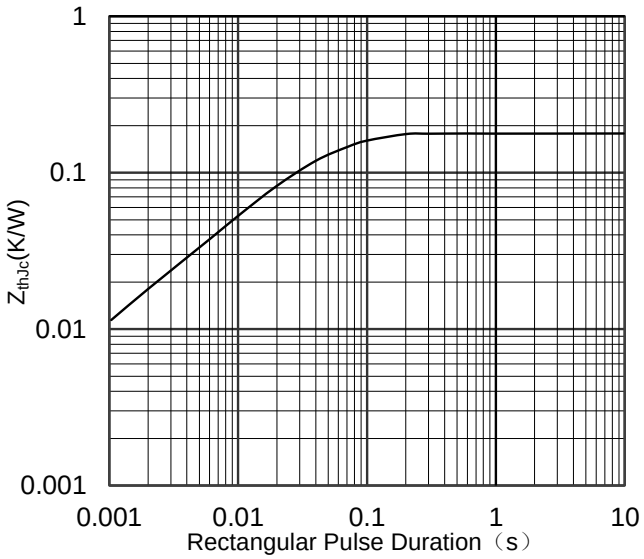


Figure 21. Transient Thermal Impedance of IGBT
（T2、T3）

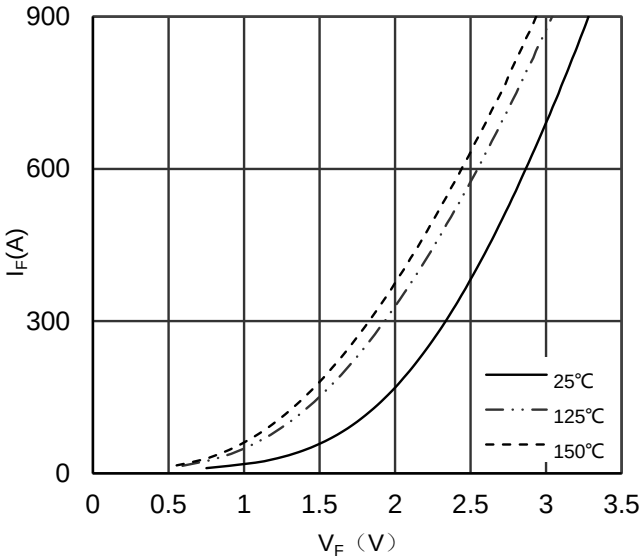


Figure 14. Diode Forward Characteristics Diode （D1）

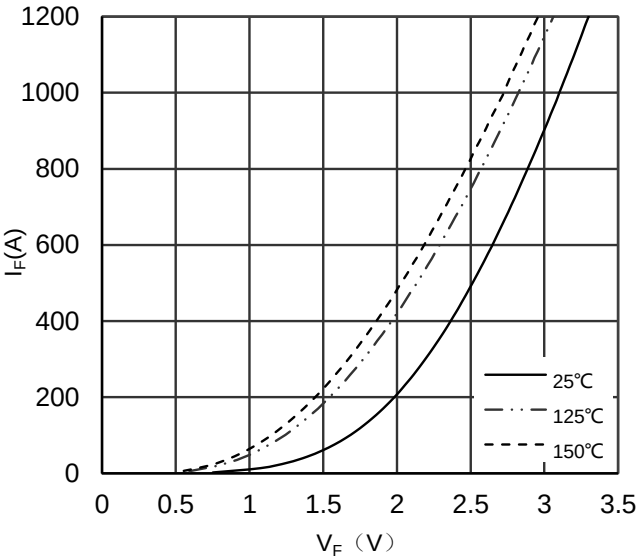


Figure 13. Diode Forward Characteristics Diode （D4）

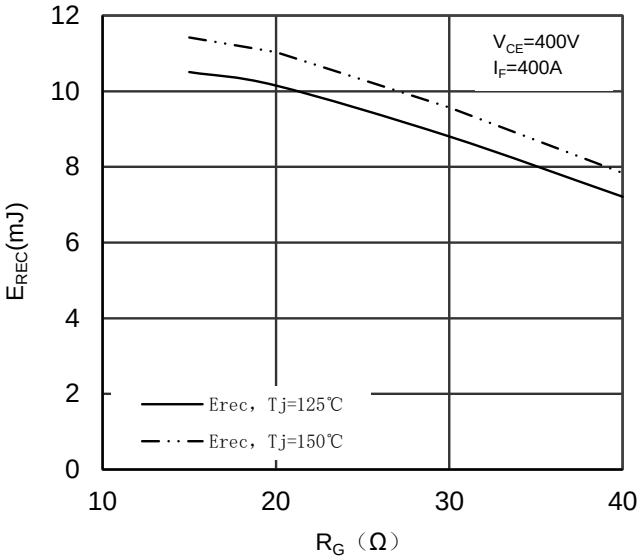


Figure 15. Switching Energy vs Gate Resistor Diode （D1、D4）

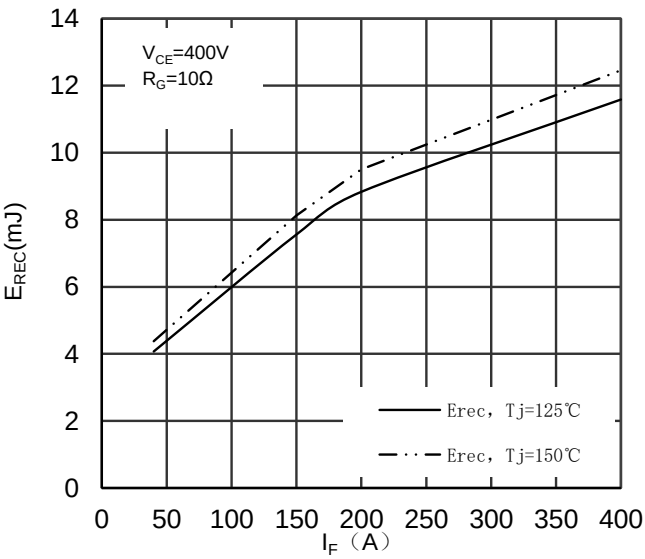


Figure 16. Switching Energy vs Forward Current Diode （D1、D4）

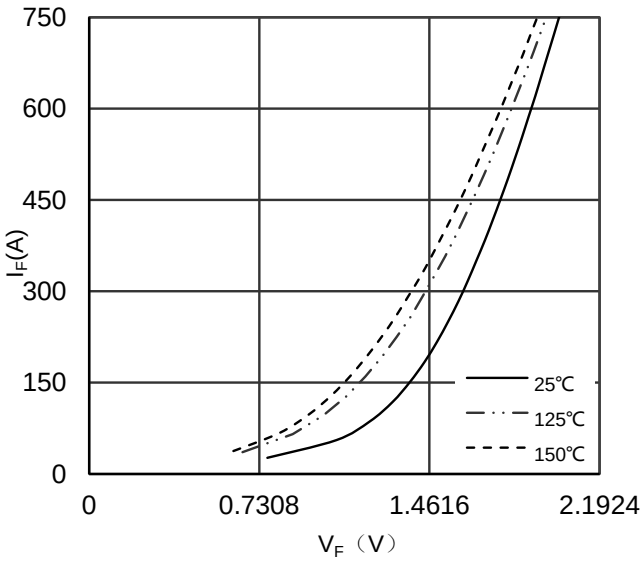


Figure 17. Diode Forward Characteristics Diode （D2、D3）

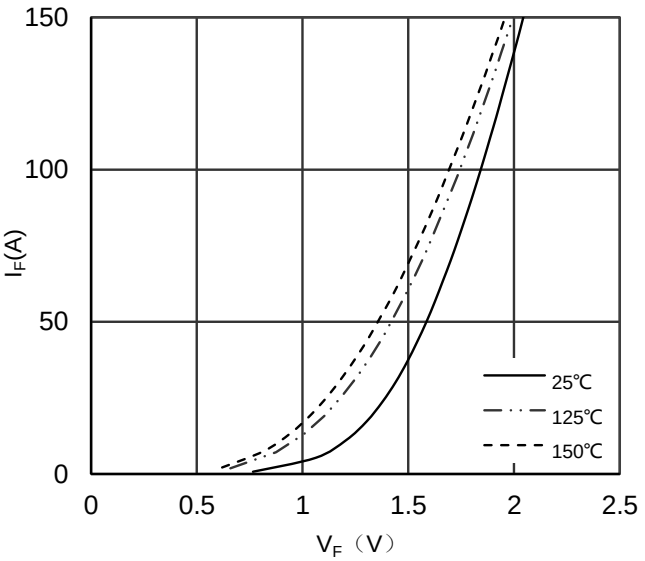


Figure 18. Diode Forward Characteristics Diode （D2-1、D3-1）

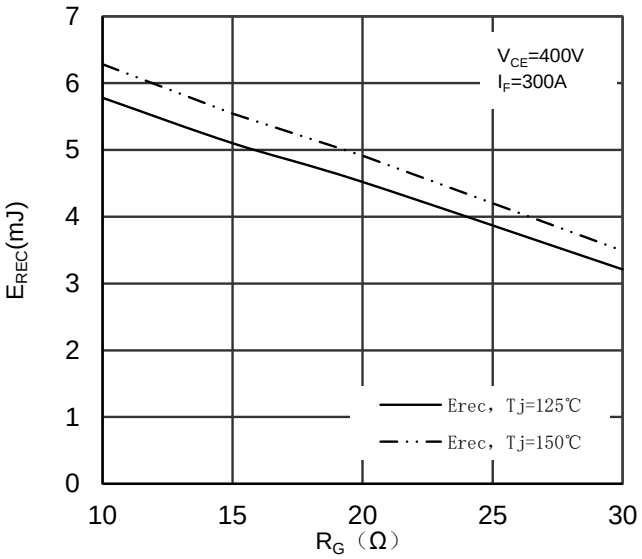


Figure 19. Switching Energy vs Gate Resistor Diode （D2、D3）

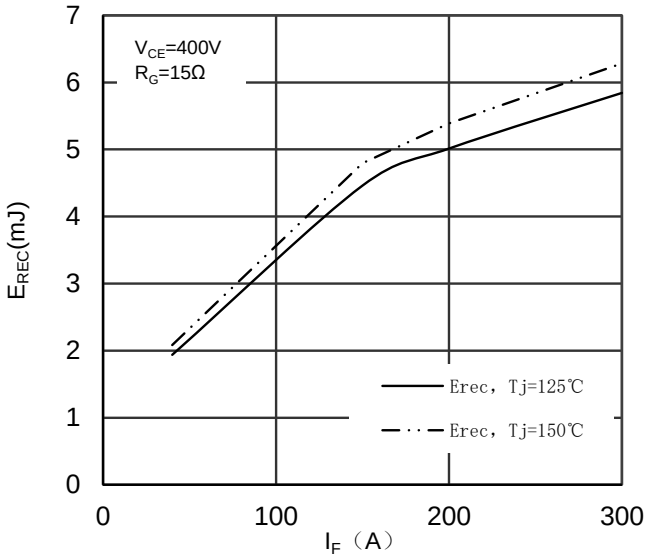


Figure 20. Switching Energy vs Forward Current Diode （D2、D3）

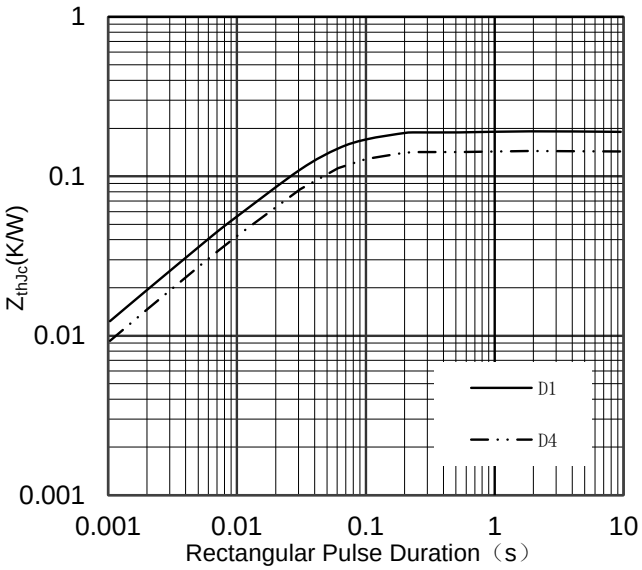


Figure 21. Transient Thermal Impedance of Diode （D1、D4）

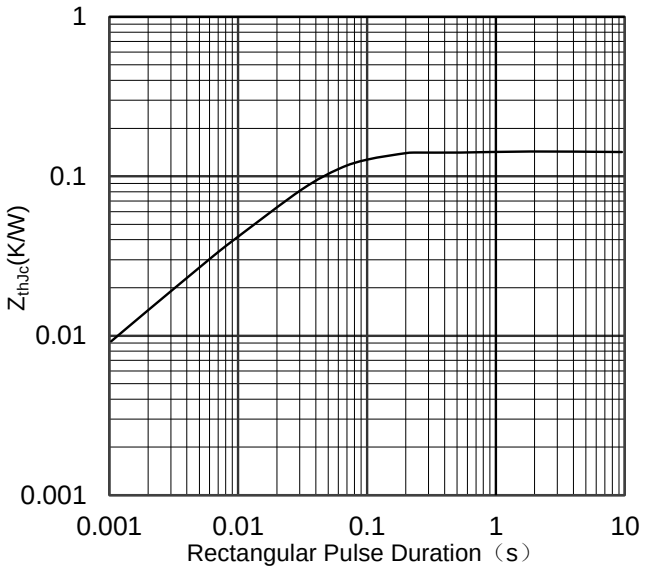


Figure 22. Transient Thermal Impedance of Diode (D2、D3)

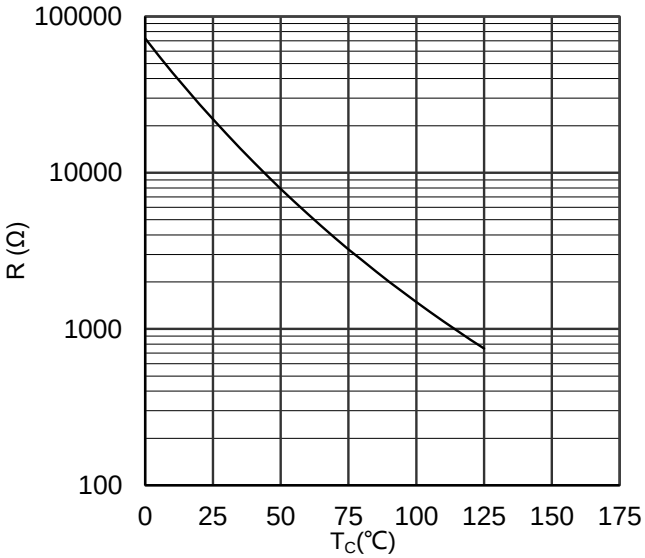


Figure 23. NTC Characteristics

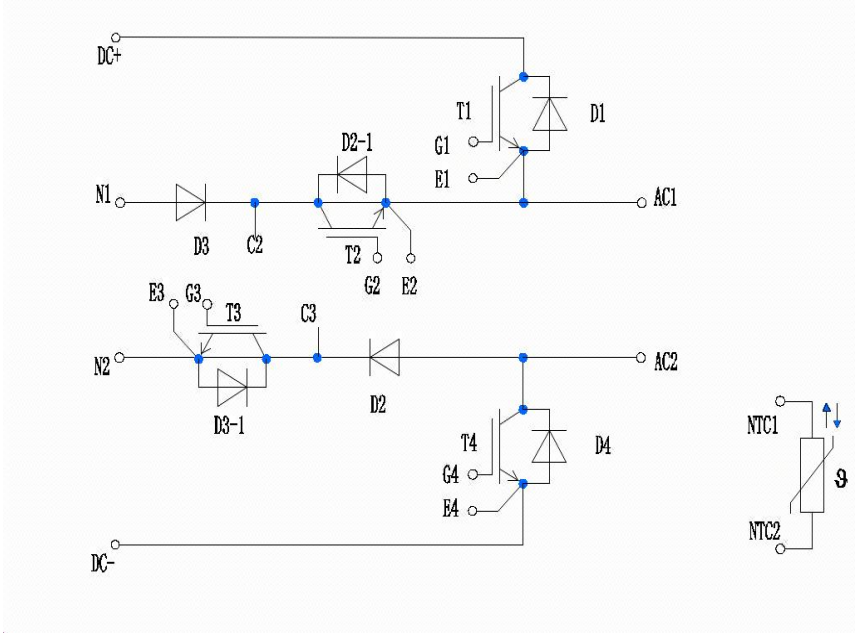
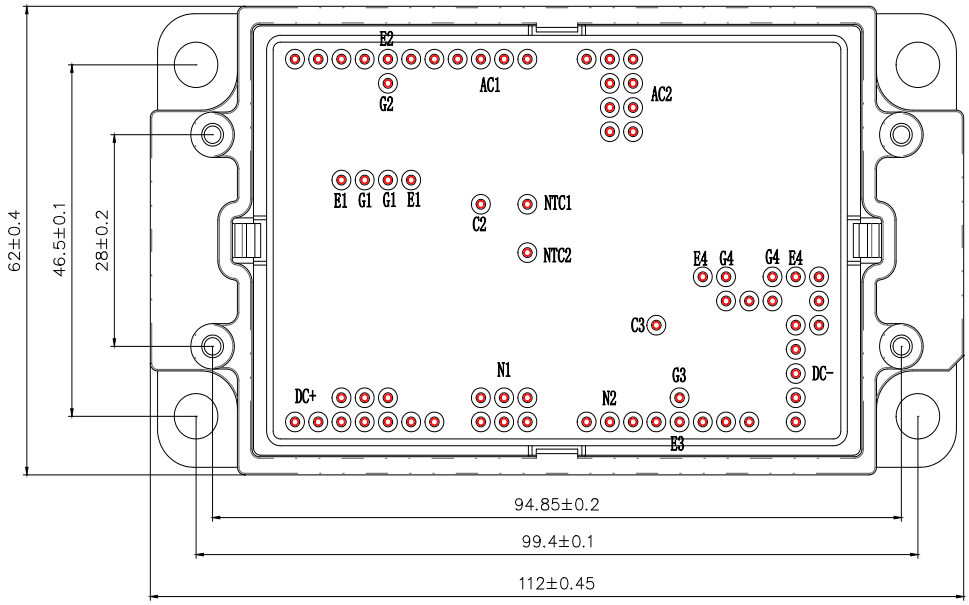
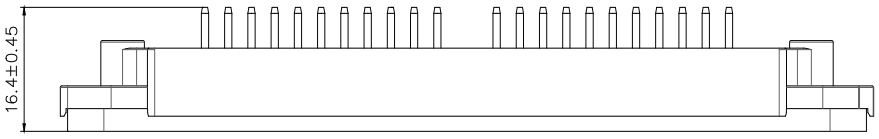


Figure 24. Circuit Diagram





Dimensions in (mm)

Figure 25. Package Outline

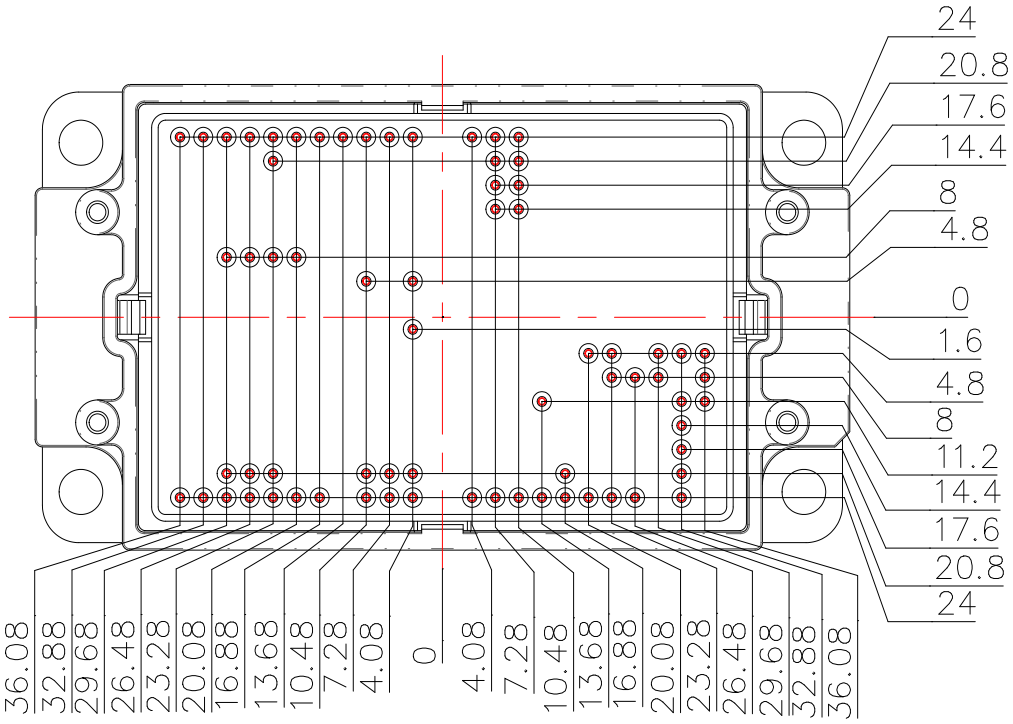


Figure 26. Coordinates