

Three-Phase Bridge IGBT 7 Power Module

MSCGX150X120CT7NMG



Product Overview

The MSCGX150X120CT7NMG device is a three-phase bridge 1200V, 150A Insulated-Gate Bipolar Transistor (IGBT) 7 power module.

The following figures show the electrical diagram and pinout location of the device.

Figure 1. Electrical Diagram

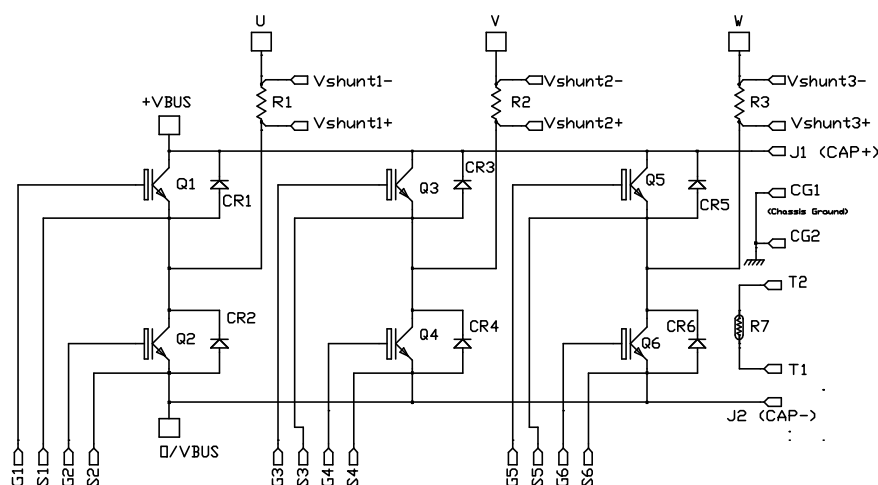
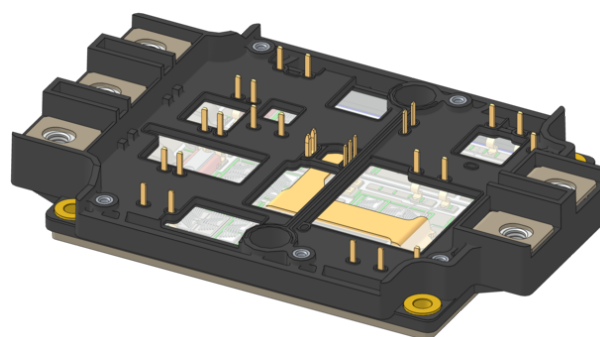
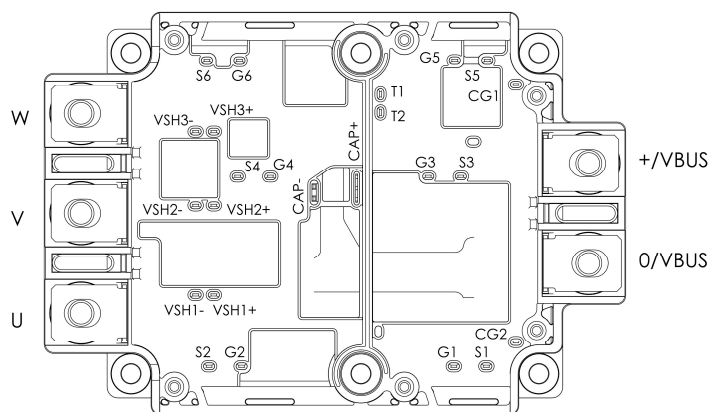


Figure 2. Pinout Location



Note: All ratings are at $T_j = 25\text{ }^{\circ}\text{C}$, unless otherwise specified.



These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

Features

The MSCGX150X120CT7NMG device has the following key features:

- IGBT 7
 - Low voltage drop
 - Low leakage current
- SiC Schottky Diode
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature Independent switching behavior
 - Positive temperature coefficient on VF
- Kelvin emitter for easy drive
- Low stray inductance
- Si₃N₄ substrate for improved thermal performance
- AlSiC baseplate for extended reliability and reduced weight
- Internal thermistor for temperature monitoring
- Extended storage temperature range

Benefits

The MSCGX150X120CT7NMG device has the following benefits:

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low inductance solution thanks to CAP DC connections to improve the HVDC decoupling
- RoHS compliant

Applications

The MSCGX150X120CT7NMG device has the following potential applications:

- Actuation system for aerospace and launch vehicle
- Power Core Module (PCM)
- Power Drive Electronic (PDE)
- Electro-Mechanical Actuator (EMA)

1. Electrical Specifications

The following sections show the electrical specifications of the MSCGX150X120CT7NMG device.

1.1. IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the MSCGX150X120CT7NMG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage	1200	V
I_C	Continuous collector current	$T_C = 25^{\circ}\text{C}$ 225	A
		$T_C = 100^{\circ}\text{C}$ 150	
I_{CM}	Pulsed collector current, t_p limited by $T_{J(max)}$	300	
V_{GE}	Gate-emitter voltage	± 20	V
	Transient gate-emitter voltage	± 25	
P_D	Power dissipation	$T_C = 25^{\circ}\text{C}$ 607	W

The following table lists the electrical characteristics (per IGBT) of the MSCGX150X120CT7NMG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	$V_{GE} = 0\text{V}; V_{CE} = 1200\text{V}$	—	—	12	μA
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}$ $I_C = 150\text{A}$	$T_J = 25^{\circ}\text{C}$	—	1.55	V
			$T_J = 125^{\circ}\text{C}$	—	1.7	
			$T_J = 175^{\circ}\text{C}$	—	1.77	
$V_{GE(th)}$	Gate threshold voltage	$V_{GE} = V_{CE}; I_C = 3.5\text{ mA}$	5.15	5.8	6.45	
I_{GES}	Gate-emitter leakage current	$V_{GE} = 20\text{V}; V_{CE} = 0\text{V}$	—	—	150	nA

The following table lists the dynamic characteristics (per IGBT) of the MSCGX150X120CT7NMG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{GE} = 0V$	—	30	—	nF
C_{oes}	Output capacitance	$V_{CE} = 25V$	—	3.8	—	
C_{res}	Reverse transfer capacitance	$f = 100\text{ kHz}$	—	0.11	—	
Q_G	Gate charge	$V_{GE} = \pm 15V$; $V_{CE} = 600V$; $I_C = 150A$	—	2.5	—	μC
$t_{d(on)}$	Turn-on delay time	$V_{GE} = \pm 15V$ $V_{Bus} = 600V$ $I_C = 150A$ $R_G = 3.3\Omega$	$T_J = 25\text{ }^\circ C$	—	172	ns
			$T_J = 125\text{ }^\circ C$	—	183	
			$T_J = 175\text{ }^\circ C$	—	189	
t_r	Rise time		$T_J = 25\text{ }^\circ C$	—	72	
			$T_J = 125\text{ }^\circ C$	—	77	
			$T_J = 175\text{ }^\circ C$	—	80	
$t_{d(off)}$	Turn-off delay time		$T_J = 25\text{ }^\circ C$	—	331	
			$T_J = 125\text{ }^\circ C$	—	414	
			$T_J = 175\text{ }^\circ C$	—	433	
t_f	Fall time		$T_J = 25\text{ }^\circ C$	—	103	
			$T_J = 125\text{ }^\circ C$	—	198	
			$T_J = 175\text{ }^\circ C$	—	262	
E_{on}	Turn-on energy	$V_{GE} = \pm 15V$ $V_{Bus} = 600V$ $I_C = 150A$ $R_G = 3.3\Omega$ $di/dt = 1700\text{ A}/\mu s$ $dv/dt = 3200\text{ V}/\mu s$	$T_J = 25\text{ }^\circ C$	—	10	mJ
			$T_J = 125\text{ }^\circ C$	—	14.9	
			$T_J = 175\text{ }^\circ C$	—	17.7	
E_{off}	Turn-off energy		$T_J = 25\text{ }^\circ C$	—	10.4	
			$T_J = 125\text{ }^\circ C$	—	15.9	
			$T_J = 175\text{ }^\circ C$	—	19.9	
R_{Gint}	Internal gate resistance		—	1	—	Ω
I_{sc}	Short circuit data	$V_{GE} \leq 15V$; $V_{Bus} = 800V$; $t_p \leq 8\text{ }\mu s$	$T_J = 150\text{ }^\circ C$	—	520	A
		$V_{GE} \leq 15V$; $V_{Bus} = 800V$; $t_p \leq 7\text{ }\mu s$	$T_J = 175\text{ }^\circ C$	—	490	
R_{thJC}	Junction-to-case thermal resistance		—	—	0.247	$^\circ C/W$

1.2. Diode Characteristics (Per SiC Diode)

The following table lists the diode characteristics (per diode) of the MSCGX150X120CT7NMG device.

Table 1-4. Diode Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	1200	V
I_{RM}	Reverse leakage current	$V_R = 1200V$	$T_J = 25\text{ }^{\circ}C$	—	30	400	μA
			$T_J = 175\text{ }^{\circ}C$	—	500	—	
I_F	DC Forward Current	$T_C = 85\text{ }^{\circ}C$	$T_J = 175\text{ }^{\circ}C$	—	100	—	A
V_F	Diode forward voltage	$I_F = 100A$	$T_J = 25\text{ }^{\circ}C$	—	1.5	1.8	V
			$T_J = 175\text{ }^{\circ}C$	—	2.1	—	
Q_C	Total capacitive charge	$V_R = 600V$		—	448	—	nC
C	Total Capacitance	$f = 1\text{ MHz}, V_R = 400V$		—	492	—	pF
		$f = 1\text{ MHz}, V_R = 800V$		—	364	—	
R_{thJC}	Junction-to-case thermal resistance			—	—	0.4	$^{\circ}C/W$

1.3. Electrical Shunt Characteristics

The following tables list the electrical shunt characteristics of the MSCGX150X120CT7NMG device.

Table 1-5. Electrical Shunt Characteristics

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_i	Resistance value	$i = 1, 2, \text{ and } 3$ $TCE = 50\text{ ppm}$	—	100	—	$\mu\Omega$
T_{Ri}	Tolerance		—	1	1.5	%
P_{Ri}	Load capacity		—	—	5	W
I_{Ri}	Current capacity		—	—	223	A

1.4. Temperature Sensor PTC

The following table lists the temperature sensor PTC of the MSCGX150X120CT7NMG device.

Table 1-6. Temperature Sensor PTC

Symbol	Characteristic	Typ.	Unit
R_0	Resistance at $0^{\circ}C$	1000	Ω
A	—	3.9083×10^{-3}	$^{\circ}C^{-1}$
B	—	-5.775×10^{-7}	$^{\circ}C^{-2}$
C	—	-4.183×10^{-12}	$^{\circ}C^{-4}$
ΔT	—	$\pm(0.3 + 0.005 \times T)$	$^{\circ}C$

For temperature range of $0\text{ }^{\circ}C$ up to $175\text{ }^{\circ}C$, $R_T = R_0 (1 + A \times T + B \times T^2)$

For temperature range of $-55\text{ }^{\circ}C$ up to $0\text{ }^{\circ}C$, $R_T = R_0 (1 + A \times T + B \times T^2 + C (T - 100) T^3)$

Where:

T: Temperature in $^{\circ}C$

R_T : Thermistor value at T

Note: For more information, see the latest application note on PTC temperature sensor, available on the Microchip website.

1.5. Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCGX150X120CT7NMG device.

Table 1-7. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Typ.	Max.	Unit
V _{ISOL}	RMS isolation voltage, any terminal-to-case t = 1 min, 50/60 Hz			4000	—	—	V
CTI	Comparative tracking index			600	—	—	—
L _{stray}	Stray inductance +VBUS 0/VBUS			—	20.9	—	nH
	Stray inductance +CAP -CAP			—	14.8	—	
d _{creep}	Creepage distance terminal-to-terminal			—	12.3	—	mm
	Creepage distance terminal-to-heatsink			—	17.4	—	
d _{clear}	Clearance distance terminal-to-terminal			—	12.3	—	
	Clearance distance terminal-to-heatsink			—	17	—	
R _{CE}	Lead resistance terminal-to-chip	T _C = 25 °C, per switch		—	1.55 ⁽¹⁾	—	mΩ
T _J	Operating junction temperature range			-55	—	175	°C
T _{JOP}	Recommended junction temperature under switching conditions			-55	—	T _{Jmax} -25	
T _{STG}	Storage temperature range			-60	—	125	
T _C	Operating case temperature			-55	—	125	
τ _M	Mounting torque	To heatsink	M4	2	—	3.5	N.m
		To terminals	M6	3	—	5	
Wt	Package weight without PCB driver			—	280	—	g

Note:

1. Shunt resistor not considered

1.6. Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the MSCGX150X120CT7NMG device.

Figure 1-1. Output Characteristics, $V_{GE} = 15V$

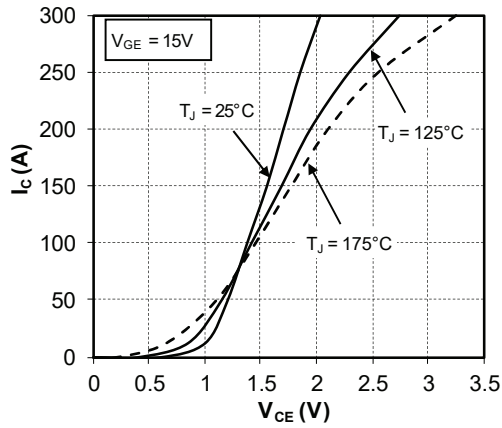


Figure 1-2. Output Characteristics, $T_J = 175^\circ C$

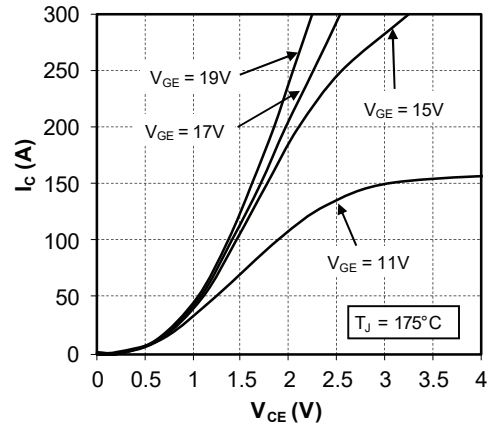


Figure 1-3. Switching Losses vs. Gate Resistance

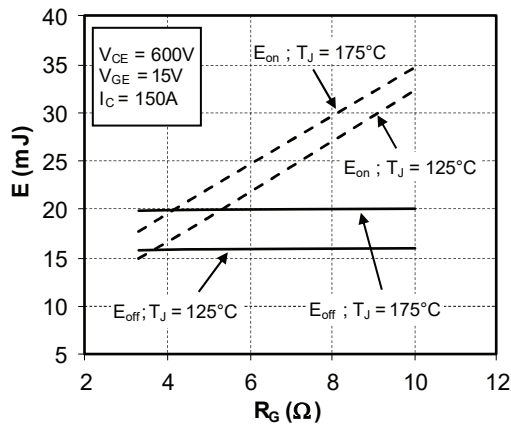


Figure 1-4. Switching Losses vs. Collector Current

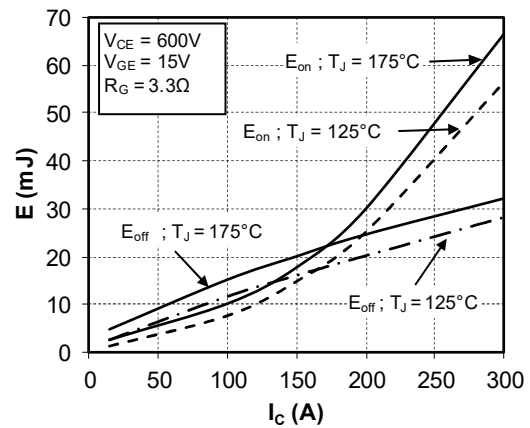


Figure 1-5. Maximum Thermal Impedance

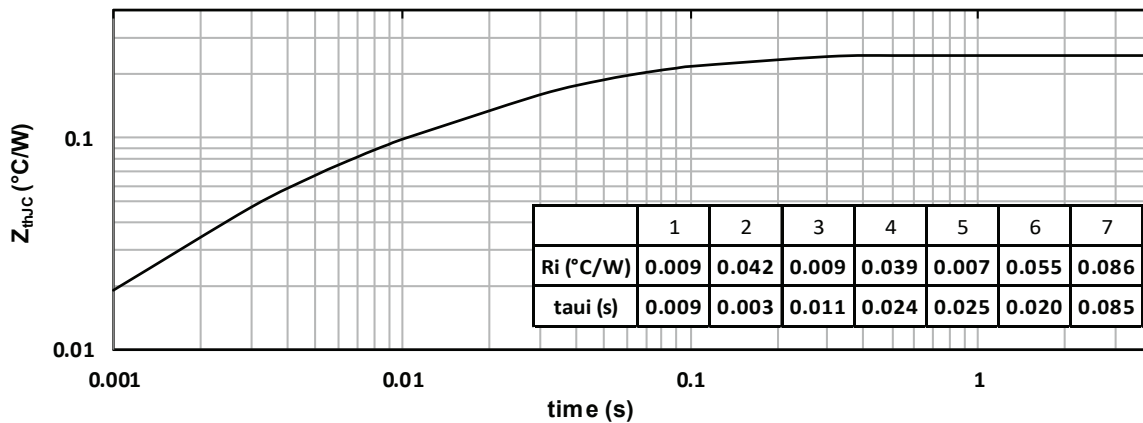


Figure 1-6. Operating Frequency vs. Collector Current

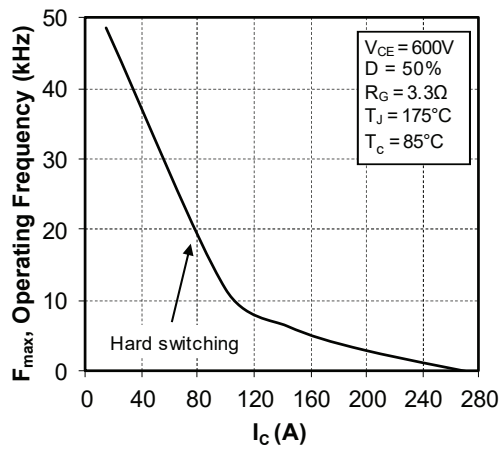


Figure 1-7. Gate Charge vs. Gate Emitter Voltage

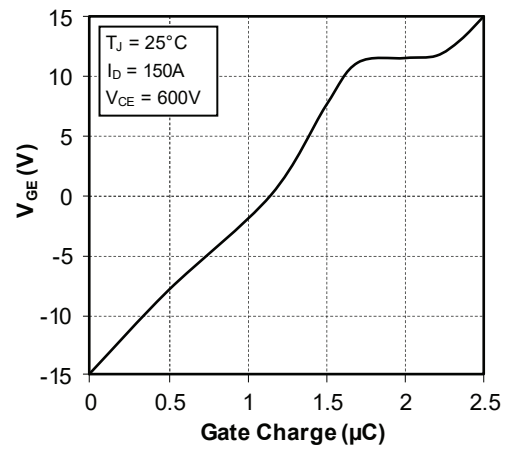


Figure 1-8. Transfer Characteristics

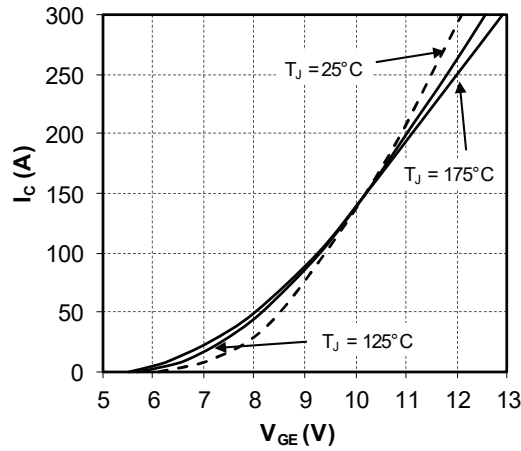


Figure 1-9. Capacity Characteristics

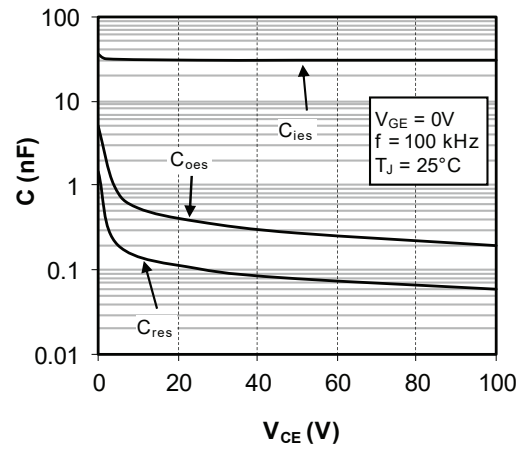
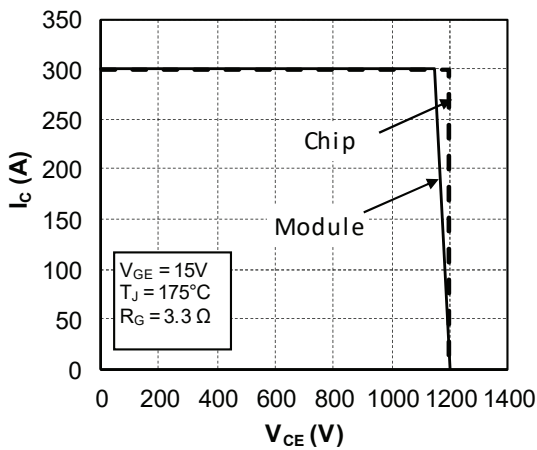


Figure 1-10. Reverse Bias Safe Operating Area



1.7. Typical SiC Diode Performance Curve

The following figures show the diode performance curves of the MSCGX150X120CT7NMG device.

Figure 1-11. Forward Characteristics

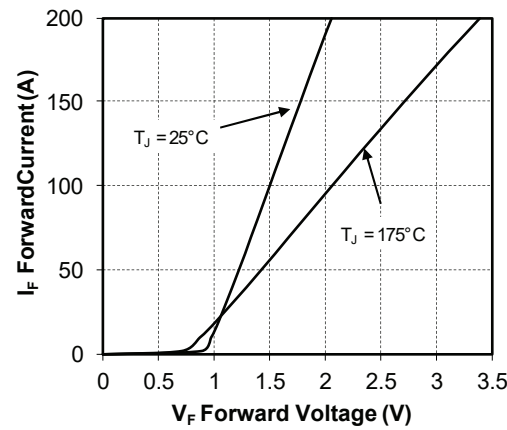


Figure 1-12. Capacitance vs. Reverse Voltage

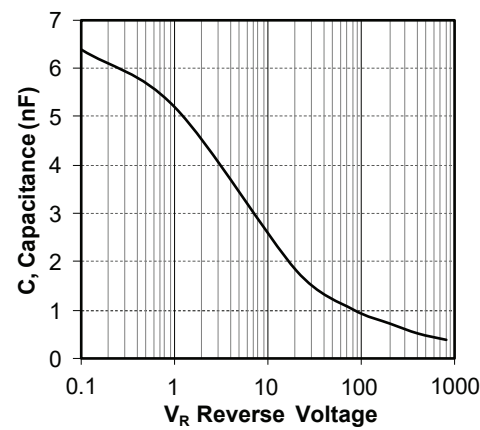
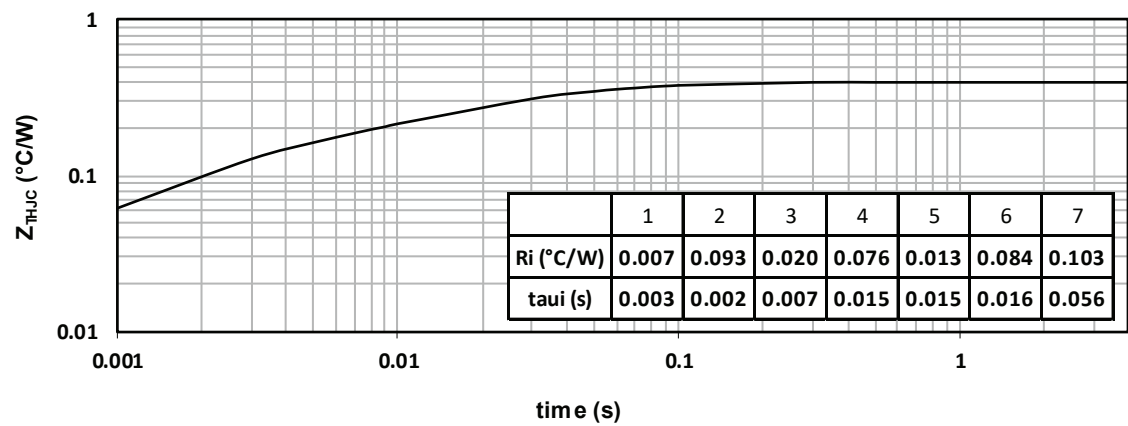


Figure 1-13. Maximum Thermal Impedance



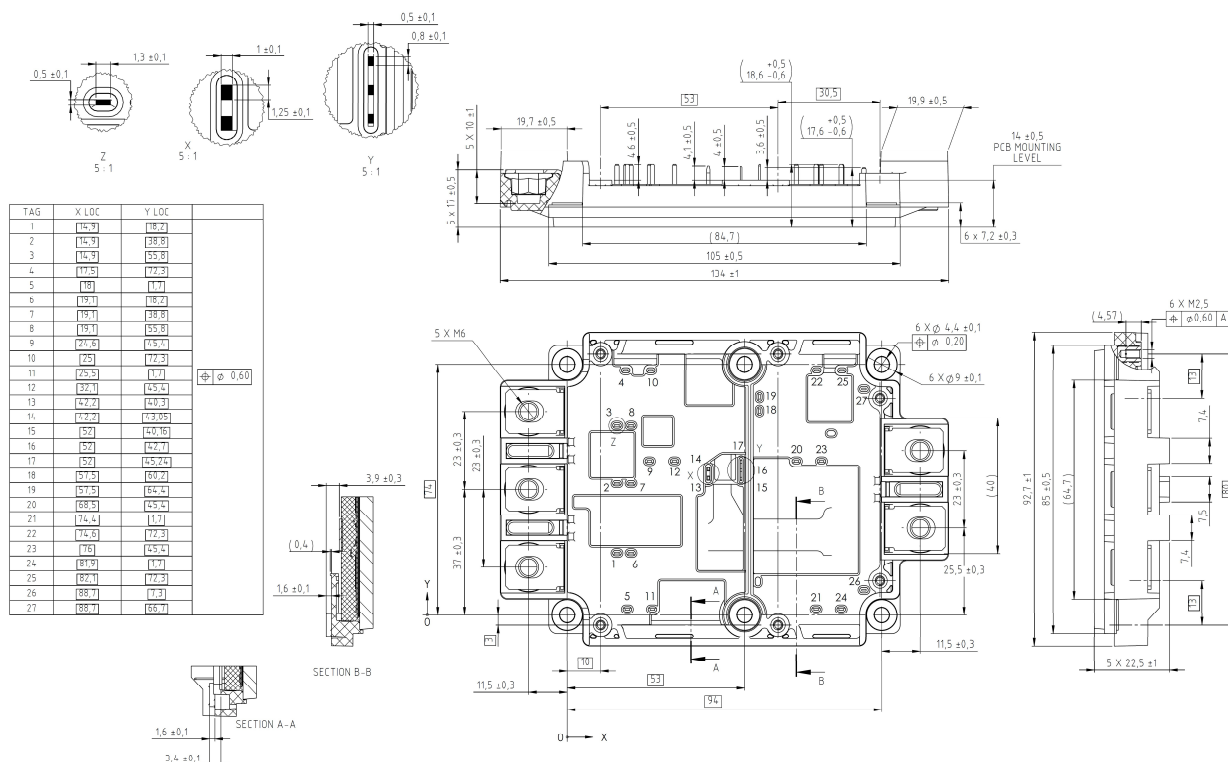
2. Package Specifications

The following section shows the package specification of the MSCGX150X120CT7NMG device.

2.1. Package Outline

The following figure shows the package outline drawing of the MSCGX150X120CT7NMG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



3. Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	04/2026	Initial revision

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