Three-Phase Bridge High-Speed IGBT 4 Power Module

MSCGLQ25X120CRTBL3NG

Product Overview

The MSCGLQ25X120CRTBL3NG device is a three-phase bridge high-speed 1200V, 25A Insulated-Gate Bipolar Transistor (IGBT) 4 power module.

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

Figure 1. Electrical Diagram

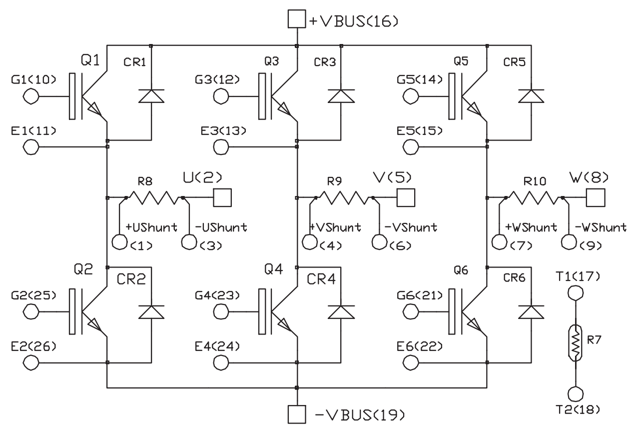
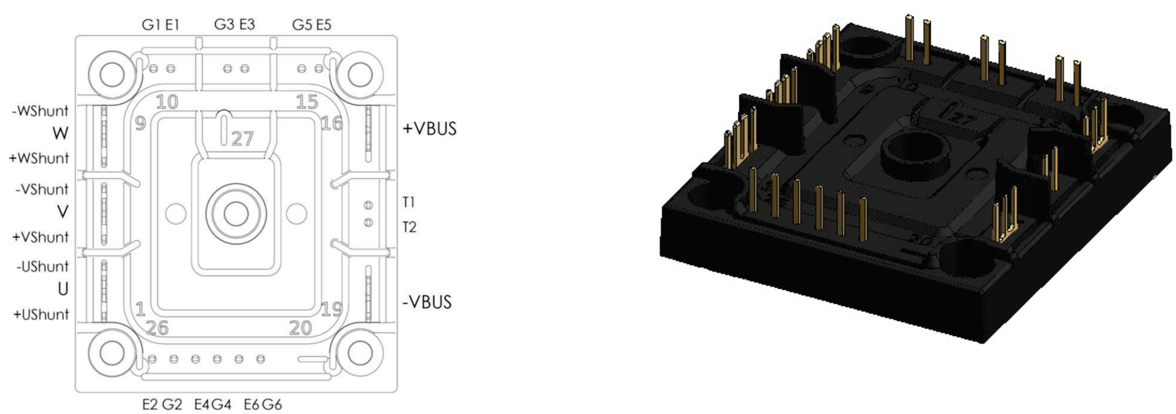


Figure 2. Pinout Location



Note: All ratings are at T_J = 25 °C, unless otherwise specified.

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

Features

The MSCGLQ25X120CRTBL3NG device has the following key features:

- High-Speed IGBT 4
  - Low voltage drop
  - Low leakage current
  - Low switching losses
- Silicon Carbide (SiC) Schottky Diode
  - Zero reverse recovery
  - Zero forward recovery
  - Temperature independent switching behavior
  - Positive temperature coefficient on VF
- Very low stray inductance
- Ultra low weight and profile
- Kelvin source for easy drive
- Si_3N_4 substrate with thick copper for improved thermal performance
- Internal thermistor for temperature monitoring
- Extended temperature range

Benefits

The MSCGLQ25X120CRTBL3NG device has the following benefits:

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Very integrated power conversion system
- Low profile
- RoHS compliant

Applications

The MSCGLQ25X120CRTBL3NG device has the following applications:

- High reliability drive
- Medium and heavy drones
- Aircraft actuation systems

1. Electrical Specifications

The following sections show the electrical specifications of the MSCGLQ25X120CRTBL3NG device.

1.1 IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the MSCGLQ25X120CRTBL3NG 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_H = 25 °C	80	A
		T_H = 100 °C	25	
I_{CM}	Pulsed collector current		90	
V_{GE}	Gate-emitter voltage		±20	V
P_D	Power dissipation	T_H = 25 °C	263	W

The following table lists the electrical characteristics (per IGBT) of the MSCGLQ25X120CRTBL3NG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	V_{GE} = 0V; V_{CE} = 1200V		—	—	50	µA
$V_{CE(sat)}$	Collector emitter saturation voltage	V_{GE} = 15V I_C = 25A	T_J = 25 °C	1.78	2.05	2.4	V
			T_J = 150 °C	—	2.6	—	
$V_{GE(th)}$	Gate threshold voltage	V_{GE} = V_{CE}; I_C = 0.85 mA		5.3	5.8	6.3	V
I_{GES}	Gate-emitter leakage current	V_{GE} = 20V; V_{CE} = 0V		—	—	150	nA

The following table lists the dynamic characteristics (per IGBT) of the MSCGLQ25X120CRTBL3NG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	V_{GE} = 0V V_{CE} = 25V f = 1 MHz		—	1430	—	pF
C_{oes}	Output capacitance			—	115	—	
C_{res}	Reverse transfer capacitance			—	75	—	
Q_G	Gate charge	V_{GE} = 15V V_{CE} = 960V I_C = 25A		—	115	—	nC
$T_{d(on)}$	Turn-on delay time	V_{GE} = ±15V V_{Bus} = 600V I_C = 25A R_G = 19Ω	T_J = 150 °C	—	26	—	ns
T_r	Rise time			—	35	—	
$T_{d(off)}$	Turn-off delay time			—	347	—	
T_f	Fall time			—	50	—	
E_{on}	Turn-on energy	V_{GE} = ±15V V_{Bus} = 600V I_C = 25A R_G = 19Ω	T_J = 150 °C	—	1.4	—	mJ
E_{off}	Turn-off energy			—	1.4	—	
I_{sc}	Short circuit data	V_{GE} ≤ 15V V_{Bus} = 600V t_P ≤ 10 µs	T_J = 150 °C	—	90	—	A
R_{thJH}	Junction-to-heatsink thermal resistance		λ = 3.4 W/mK	—	0.57	—	°C/W

1.2 SiC Diode Characteristics (Per SiC Diode)

The following table lists the SiC diode characteristics (per SiC diode) of the MSCGLQ25X120CRTBL3NG device.

Table 1-4. SiC 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 °C	—	10	200	µA
			T_J = 175 °C	—	150	—	
I_F	DC forward current		T_H = 100 °C	—	30	—	A
V_F	Diode forward voltage	I_F = 30A	T_J = 25 °C	—	1.5	1.8	V
			T_J = 175 °C	—	2.1	—	
Q_C	Total capacitive charge	V_R = 600V		—	130	—	nC
C	Total capacitance	f = 1 MHz V_R = 400V		—	141	—	pF
		f = 1 MHz V_R = 800V		—	105	—	
R_{thJH}	Junction-to-heatsink thermal resistance		λ = 3.4 W/mK	—	0.854	—	°C/W

1.3 Electrical Shunt Characteristics

The following tables list the electrical shunt characteristics of the MSCGLQ25X120CRTBL3NG device.

Table 1-5. Shunt (R8 to R10)

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_i	Resistance value	i = 8, 9, and 10	—	10	—	mΩ
T_{Ri}	Tolerance	TCE = 50 ppm	—	1	1.5	%
P_{Ri}	Load capacity		—	—	3	W
I_{Ri}	Current capacity		—	—	17	A

1.4 Temperature Sensor NTC

The following table lists the temperature sensor NTC of the MSCGLQ25X120CRTBL3NG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic		Min.	Typ.	Max.	Unit
R_{25}	Resistance at 25 °C		—	50	—	kΩ
$\Delta R_{25}/R_{25}$	—		—	5	—	%
$B_{25/85}$	T_{25} = 298.15K		—	3952	—	K
ΔB/B	—	T_H = 100 °C	—	4	—	%

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
R_T: Thermistor value at T

Note: For more information, see APT0406—Using NTC Temperature Sensor Integrated into Power Module.

1.5 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the MSCGLQ25X120CRTBL3NG device.

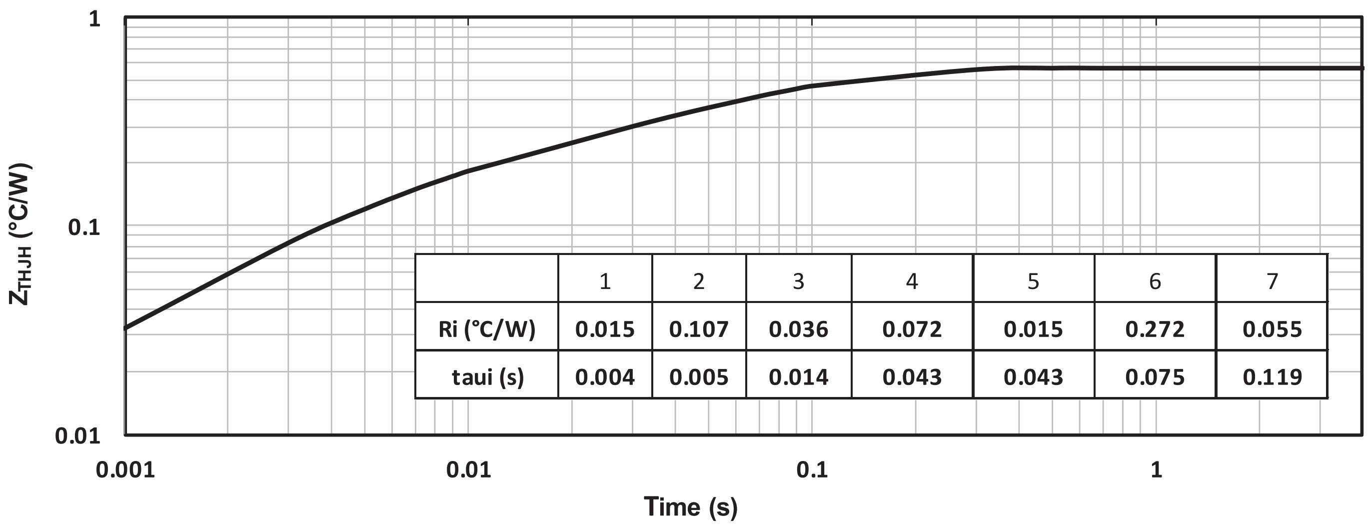
Table 1-7. Thermal and Package Characteristics

Symbol	Characteristic			Min.	Typ.	Max.	Unit
V_{ISOL}	RMS isolation voltage, any terminal to case t = 1 min, 50/60 Hz			2500	—	—	V
CTI	Comparative tracking index			600	—	—	—
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			–55	—	125	
T_C	Operating case temperature			–55	—	125	
Torque	Mounting torque	To heatsink	M3	0.7	—	0.9	N.m
Wt	Package weight			—	32.5	—	g

1.6 Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the MSCGLQ25X120CRTBL3NG device.

Figure 1-1. Junction-to-Heatsink Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	**0.015**	**0.107**	**0.036**	**0.072**	**0.015**	**0.272**	**0.055**
taui (s)	**0.004**	**0.005**	**0.014**	**0.043**	**0.043**	**0.075**	**0.119**

Figure 1-2. Output Characteristics, V_{GE} = 15V

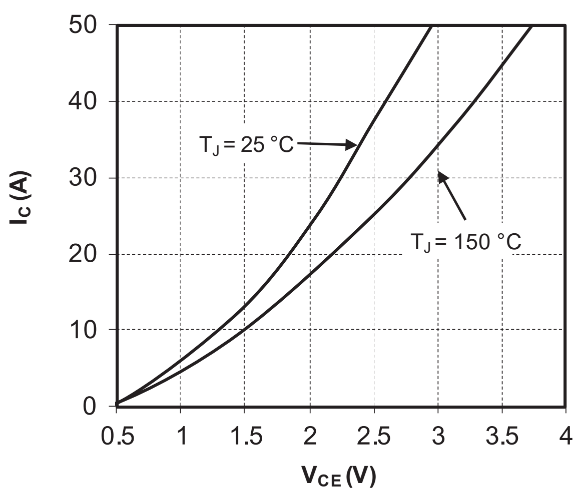


Figure 1-3. Output Characteristics, T_J = 150 °C

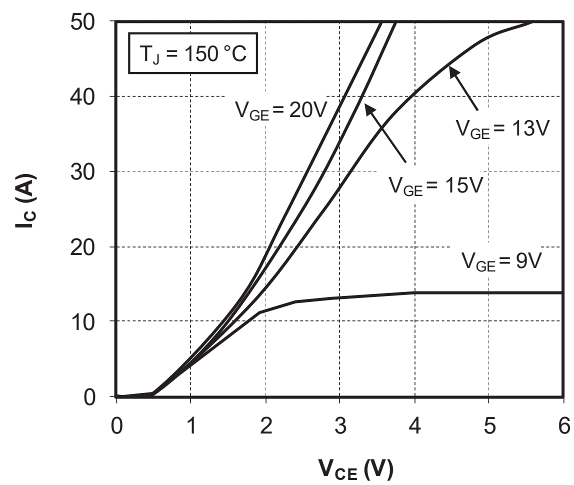


Figure 1-4. Transfer Characteristics

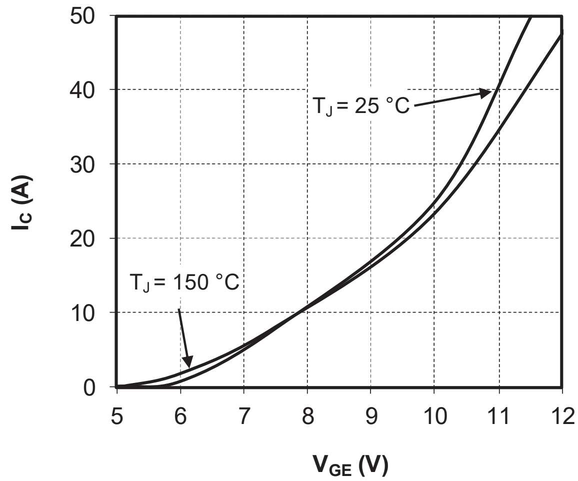


Figure 1-5. Energy Losses vs. Collector Current

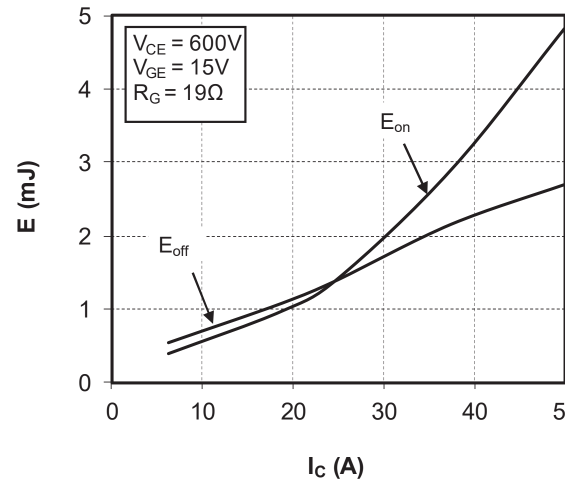


Figure 1-6. Switching Energy vs. Gate Resistance

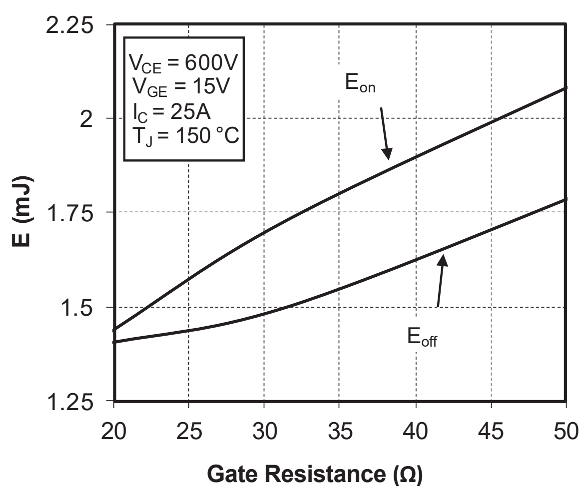
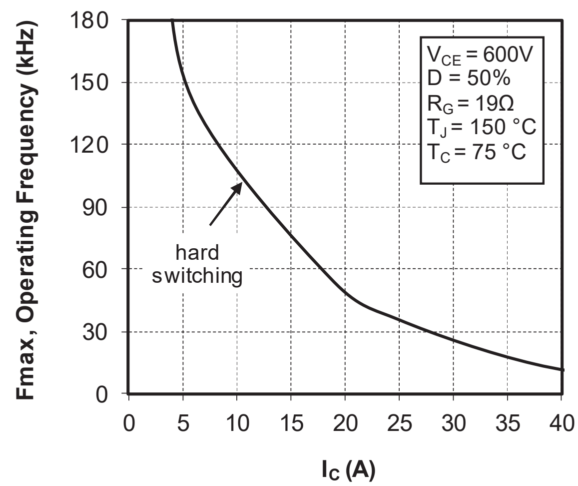


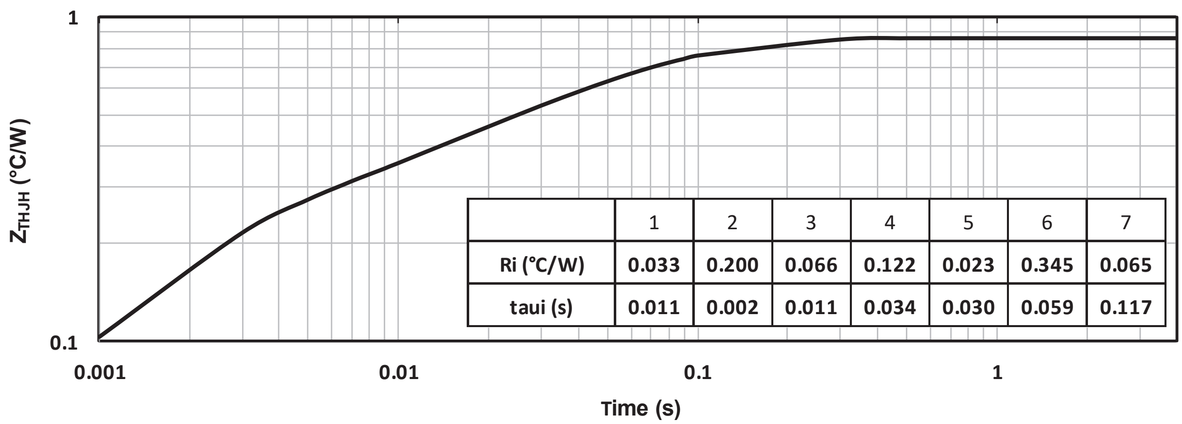
Figure 1-7. Operating Frequency vs Collector Current



1.7 Typical SiC Diode Performance Curve

The following figures show the SiC diode performance curves of the MSCGLQ25X120CRTBL3NG device.

Figure 1-8. Junction-to-Heatsink Thermal Impedance



	1	2	3	4	5	6	7
Ri (°C/W)	0.033	0.200	0.066	0.122	0.023	0.345	0.065
taui (s)	0.011	0.002	0.011	0.034	0.030	0.059	0.117

Figure 1-9. Forward Characteristics

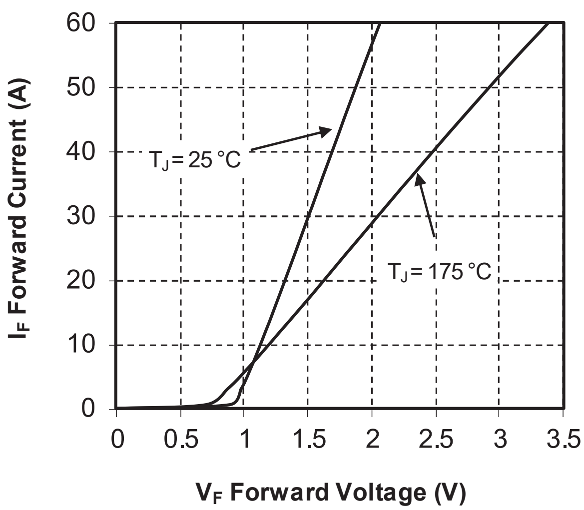
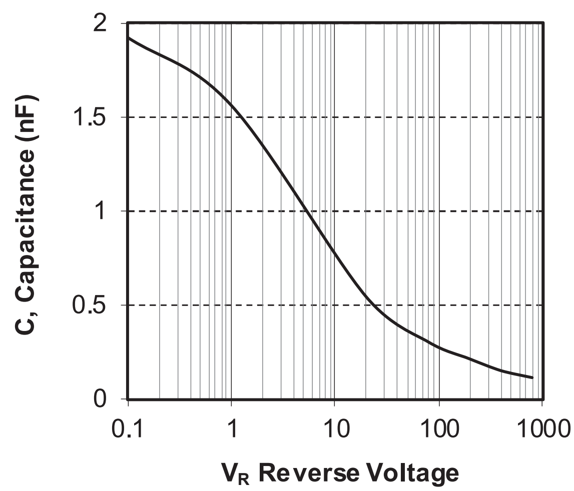


Figure 1-10. Capacitance vs. Reverse Voltage



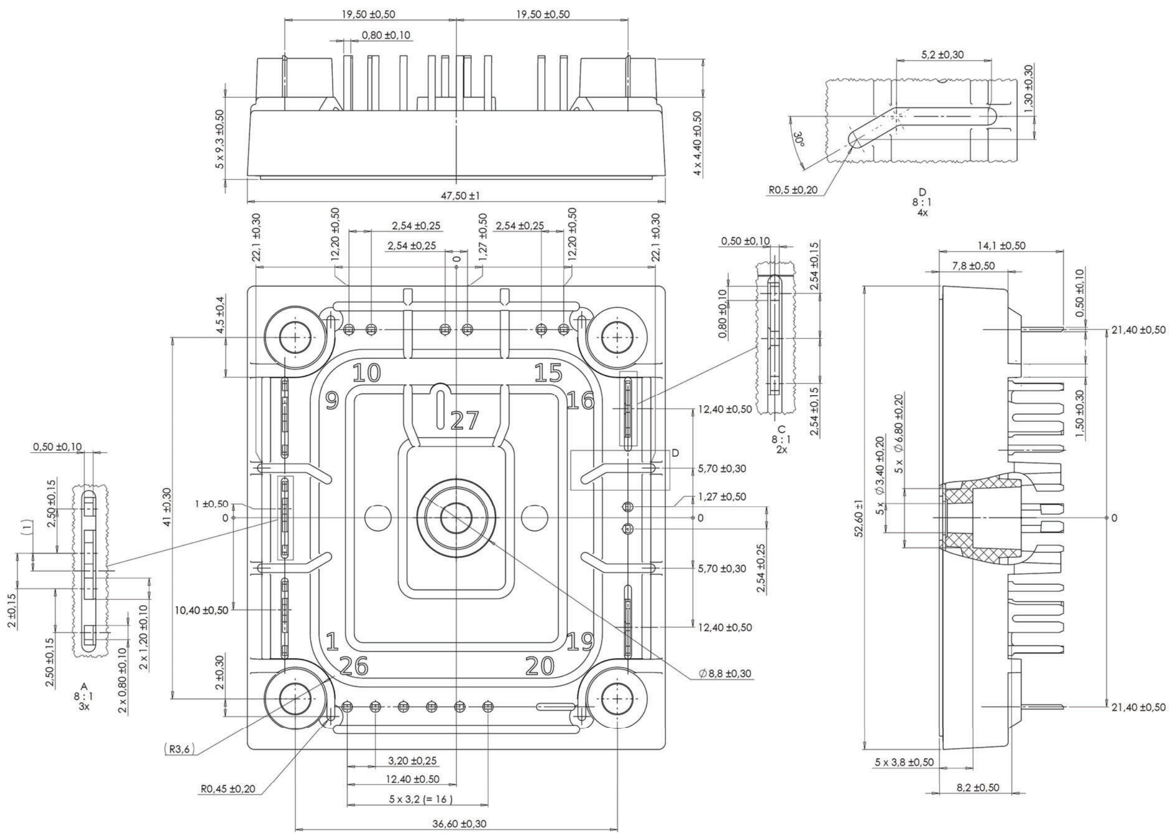
2. Package Specifications

The following section shows the package specification of the MSCGLQ25X120CRTBL3NG device.

2.1 Package Outline

The following figure shows the package outline drawing of the MSCGLQ25X120CRTBL3NG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: For more information, see application note AN4306-Mounting Instruction for Baseless Power Module.

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	09/2023	Initial revision

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